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Health Mobilization Series G-2

preparing the hospital plant for emergencies

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE Public Health Service

ACKNOWLEDGMENTS

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Illustrations

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Health Mobilization Series G-2

SERVICES
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1969

preparing the hospital plant for emergencies

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration
Division of Health Mobilization

PREFACE

The articles in this publication deal with the emergency preparedness of the hospital plant and are reprinted from selected hospital journals. They discuss facility design for fallout shelter and emergency operations, disaster communications systems, and alternate or auxiliary utilities equipment.

This book is a companion volume to "Hospital Planning for National Disaster" (Public Health Service publication No. 1071–G–1, Revised 1967). It is intended, primarily, to assist hospital boards, architects, administrators, and engineers in planning for effective operations in a disaster situation. Another source of disaster planning material is "Readings in Disaster Planning for Hospitals," published by the American Hospital Association.

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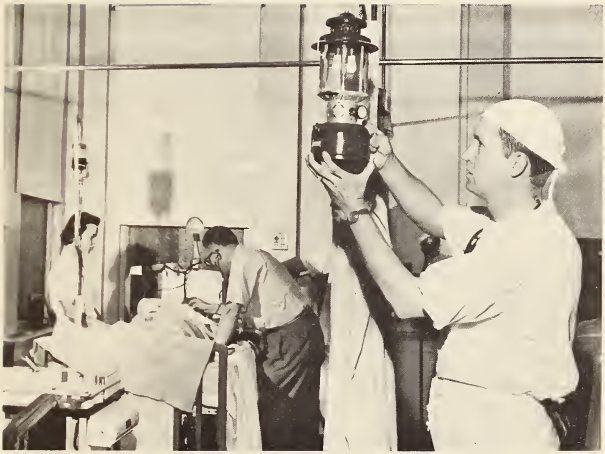
UTILITIES



DISASTER PLANNING SHOULD INCLUDE UTILITIES

Daniel M. Roop, P.E.

Electricity

In a disaster, electrical failure of any kind, in any physical plant, is generally the first utility service to be disrupted, thus disrupting all the areas in the hospital. Some departments are affected to a greater degree than are others, and in these areas the immediate results are far more important, requiring instant emergency power.

Emergency Power

One source of emergency power to feed these areas could come from a standby generator of sufficient size to supply the estimated current demands on the final list of areas desired. Regulations and codes have been established on a national basis requiring that most hospitals be supplied with two entirely independent sources of outside power. This could come from a network or grid system in the community itself. It must be realized that in the event of a catastrophe, perhaps both of these independent sources of power could fail. The standby generator, operated by a prime mover, powered either by gasoline, diesel fuel, or a natural gas, internal combustion engine, or steam turbine, should be given major consideration. Most of the hospitals today require alternating current, and the third alternate source of emergency power, namely storage batteries, is not considered as a feasible solution to the problems of operation faced by today's hospital. The only practical area in which power facilities from a direct current source could possibly prove worthwhile would be that of the telephone switchboard room and equipment and possibly some lighting. Under most conditions the telephone company provides and maintains standby emergency service on this basis as a part of their normal installation.

A second utility primary feeder service from a separate generating plant is generally more dependable than automatic starting of any type of internal combustion engine, which, no doubt has remained idle for several days. However, an emergency generating unit in a hospital has important advantages over the second utility service, and is more desirable in view of disasters

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or possible enemy action. For emergency service, natural gas or gasoline engine generators are the most commonly used for capacities up to 15 kw. For capacities greater than 15 kw, diesel engine generators are the most common choice. Steam turbine generating units are currently available in capacities of 10 kw and higher. The steam generating unit does offer an economy of installation and overcomes the problems that many gasoline, diesel, or gas combustion engines have in meeting national and local code installation requirements.

These areas need an alternate source of power

The emergency electrical system in hospitals may cover the following areas, and should be fed from an alternate emergency source of power.* All of these items may not necessarily prove important enough in any given installation; however, it is felt that during the planning stages for emergency service they should all be given careful and just review.

- Stairways designated as fire exits.
- Corridors leading to exits and exit stairs.
- Patient corridors.
- Nurse call systems.
- At least one maximum rise elevator in each building which houses patients and is four stories or more in height.
- Exit signs and exit direction signs.
- Telephone switchboard room.
- Operating, delivery and emergency rooms—include illumination and wall receptacles.
- Newborn, pediatric and premature infant nurseries—same requirements as for operating rooms.
- Areas designated as poliomyelitis wards, intensive care units.
- Blood bank and bone bank.
- Refrigeration equipment.
- Power plant and mechanical plant equipment.
- Electrical transformer room and main panel board area.
- Psychiatric patient areas.
- Internal communications system and fire alarm sytems.

There are many other areas which should receive consideration from the administrators of the hospital in question.

In picking your generating equipment, consider allowing a maximum of 125 percent overload for an average 2 hours running time. This will enable you to purchase a smaller generator, thus saving in your initial cost installations, and still have the benefits of a larger generator. However, if the disaster or failure of the utility power requires that the generator be operated

*For additional data refer to NFPA 67T. Proposed Standard for Hospital Emergency Electrical Systems.

for any great length of time, we'll say 4 or more hours, it would be necessary to decrease the load on such a unit.

Recent proposals taken for the installation of a 60-kw, 75-kva, steam-driven-type turbine generator were $18,900 for a complete installation. This included all of the automatic transfer switches, wiring, and other devices required for control and operation of this unit to cover an area originally operated as a 500-bed hospital. The breakdown of this cost is $315 per kilowatt. The generator itself, in this instance, cost $12,000. This proposal did not include any requirements for fuel oil storage, either above or under ground. The physical proximity of the hospital plant in relation to fuel oil storage is a major consideration and can ofttimes be a costly item in the installation of emergency generating equipment.

For budgeting purposes, in determining the installation of emergency generating equipment in your hospitals, a cost figure of $450 per kilowatt will be ample to enable management to determine the advisability and economics of the installation of such equipment. This cost does not include the distribution systems to corridors and patient areas as these will vary by region, locale, or hospital needs.

Keep in mind that the operating voltage and frequency characteristics of any emergency system should be suitable for operating lights or equipment normally energized by your local utility service. Government surplus units must be carefully considered by a competent engineer. Incandescent filament lamps should operate satisfactorily on either a.c. or d.c., interchangeably. Electric discharge lamps, however, such as fluorescent, mercury, and sodium-vapor lamps, and ordinary motors do not operate satisfactorily, except on the type of current for which they were designed. These are major points and should receive technical consideration in your wiring circuits for emergency power systems. All of the system should be fully automatic, with the transfer switches and devices necessary to switch over immediately upon failure of the primary service to your hospital.

Any emergency electrical system of the types described should be maintained so as to be capable of supplying service within the shortest time practicable. While there is no line of authority necessarily between the design engineer and the hospital engineer, the design engineer can greatly influence proper maintenance by specifying the most dependable equipment of its kind, and by locating the equipment so as to be conveniently accessible.

Engine-driven generators should be tested and operated at least weekly. Storage batteries used for emergency lighting or for starting of emergency generating units should be inspected at regularly scheduled intervals, and whatever times are deemed necessary, such factors being set forth by the style, type of battery, and as recommended by the manufacturer.

An emergency power system should be a must in every hospital or treatment facility. Design of emergency power systems for hospitals as affected by climate and local conditions are very important considerations.

Water Supply

A potable water supply is our next important topic where emergency measures are necessary. In a local catastrophe, it can be assumed that complete failure of the municipal water system may result. In such an instance, the hospital would be required to have plans for a water supply. The type of water supply distribution system that the hospital has installed in its existing plant facilities would dictate the measures required for overcoming the loss of this primary water supply. There are generally three recognized water distribution systems in hospitals today:

1. Direct water supply from the city mains with no auxiliary pumping equipment.
2. Auxiliary pumping equipment pumping water directly into the hospital distribution system.
3. A downfeed system from house tanks in the building proper or from an elevated storage tank on the premises.

Obviously the hospital with a direct-feed system would be immediately affected when municipal water supply was discontinued. This would mean that immediate measures would be required to provide water for this hospital. Under circumstances, as per item two, the same conditions would prevail. For item three, the hospital would perhaps have a reserve of water in their storage tanks for possibly as long as 2 or 3 hours, with certain restrictions.

Immediate notification must be given to all departments when storage tanks are available so that water may be rationed. That would enable hospital personnel to have a little more time to arrange for an emergency source of water. Laundry services should be temporarily suspended until an ample water supply has been restored.

In all cases, the emergency source of potable water may be from the local dairy, either bottled water or through the use of dairy tank trucks.

Distribution of the water from the time it is brought to the hospital should receive consideration also.

Many hospitals today have deep wells as an emergency source of water. Such pumping equipment should be connected with the emergency generator, as well as the primary power supply. However with the geological changes throughout the entire country in the natural water table, it is ofttimes difficult to obtain permits for the installation of such wells.

Gas

Today, more and more plants are using natural gas as fuel for their boilers. There should be an emergency source of supply if this gas supply is disrupted. Most communities require, during the initial installation of such powerplants, that oil standby equipment be installed. Ofttimes the demand

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for natural gas is so high during extremely cold weather that the communities find it necessary to discontinue gas service to industries first, and ofttimes to hospitals, as a result of a lack of supply-main capacity to carry the required demand in a given community. Therefore, your standby oil firing equipment under such conditions could serve not only during a disaster, but during normal hospital operations.

In those hospitals that burn solid fuels, a stockpile of solid fuel is a must and should be based on a minimum of 2 weeks disruption of normal supplies. However, these plants may also be equipped with oil standby service for firing the boilers.

If gas is used for cooking, alternate facilities must be available for boiling water and supplying at least hot liquids and soups during a disaster period. Such standby equipment might include kerosene stoves, bottled gas, or diesel stoves. It might be advisable to store bottled gas, orifices, and other parts that could be interchangeable with your natural or low-pressured gas burners necessary in existing gas-burning equipment. The former equipment would have to supplement electrical cooking facilities in the event of a power failure as discussed previously. Current design criteria in new hospitals is specifying both gas and electrical cooking equipment.

Oxygen services should be considered in this phase of utility distribution. Although not a utility in itself, current practice today in old hospitals, as well as new hospitals, is to install central oxygen systems. The main oxygen supply may be damaged during a disaster. The prime source of oxygen may become void, and it would be necessary to rely on the emergency cylinder system. If additional cyclinders are required, plans should be made to either connect these to the central manifold or oxygen therapy should be administered from the cylinders directly at the patient's bedside.

Heating

Closely allied with the failure of natural gas or solid fuels for firing boiler equipment is the technical problem relative to maintaining comfort conditions within the hospital plant. The use of steam and/or hot water for heating today is common practice. Without gas or standby fuel to fire the boilers, no heat could be made available in either instance. It is of utmost importance, therefore, that emergency facilities be provided in the powerplant for maintaining operation of the boilers. It ofttimes happens that such boilers and boiler plants are constructed on low ground, and during flood conditions the complete plant is knocked out of service. In planning and designing, these factors should be taken into consideration.

Let us assume that the main-source fuel, and also perhaps the standby fuel, has been disrupted and no heat source from the central plant is available. There are on the market today, and no doubt available through local contractors, depending on the geographical area of your plant, portable heating

units that operate from kerosene or gasoline. These units, although not hazardous in their operations, do pose some odor problems. However, they will give a source of heat in the event of an emergency and are perfectly safe to operate in patient areas.

I believe it is agreed that emergency considerations need not be given to cooling refrigeration equipment of central air-conditioning systems as it is felt these items could be disrupted without materially affecting the operation of the hospital during the time of a disaster. Ventilating equipment failure could affect operations in some systems, and therefore should be given priority in electrical studies.

Sterilization

Sterilizing techniques, if there is a failure of steam, will have to be changed, and consideration should be given to alternate methods of sterilization in the central supply areas and operating room suites. If the hospital is within the city limits, or reasonable distance from larger cities, it would be possible to pipe steam from a locomotive boiler or use a portable steam generator with sufficient capacity to handle the basic needs for sterilization, and even possibly some minimum heating requirements in such areas as operating rooms, nurseries, and polio wards.

There are many technical problems involved in this distribution and processing of steam. Of course, water is just as important as fuel. Although fuel facilities may be available, unless there is water there can be no steam. At the same time there might be a sufficient water supply, but no fuel supply with which to fire the boilers.

Sanitation

Disposal of any sanitary waste during any disaster plan is of utmost importance so as to prevent any type of epidemic and spread of disease through faulty handling of such wastes. With a lack of water and the municipal sewer system out of order, special containers must be provided by which sanitary waste can be removed from the building.

If companies are in business in the vicinity of your hospital that provide residential septic tank service, make arrangements ahead of time to have them report to the hospital where they can pump the sewerage waste from sump pits which are generally constructed in the ground floor areas of most buildings. This would make it possible to dispose of sanitary wastes without any direct handling by hospital personnel.

Another, and most frequent, waste disposal problem is that of dry refuse and wet refuse, such as garbage. These items are ofttimes overlooked in disaster planning, and become a safety hazard and a nuisance if advanced planning has not been taken into consideration. For the hospital of today

that has its own incinerator or destructor, the disposal of dry wastes does not pose any great problem. The disposal of garbage and other wet refuse, however, does pose a problem in the event that auxiliary firing equipment in the destructor should fail because of damage to natural gas supplies or diminished oil supplies.

In the country areas, such waste may be taken care of by a sanitary fill method, keeping in mind that advanced plans must be made to rent earth-moving equipment for such disposal. If the roads are open and trucks are able to visit the hospital regularly, the problem is somewhat minimized.

Do not fail to consider that carriers of all types—buckets, G.I. cans, waste-baskets, etc.—are going to be at a premium during such a disaster. Ample supplies of these items should be available for sanitary and waste disposal, and each should be marked for its specific service during disaster periods. Care must be taken to completely sterilize all such containers upon reuse by any hospital department.

Communications

Communications are a vital asset to the proper functioning of the master disaster plan. If outside communications such as telephones should fail during a local catastrophe, other sources of communication must be available in addition to personnel. Such emergency methods of communication may be via radio, either installed in the hospital proper, or by the local radio stations, police, and U.S. Government forces.

Internal communications also may pose a problem if there is a power failure. Walkie-talkie battery operated units can offer a solution to this problem and enable all of the departments to keep in touch with the director or central pool, whatever the case may be.

The nurse-to-patient communications will suffer the most in the event of power failure, Consideration should be given to including the nurse-call amplifying equipment on the emergency electrical system, as well as other communications and alarm systems and devices. However, in the event that this is not feasible, then the power-operated battery units should be given to the most critical patients, and surveillance by hospital personnel will suffice for the ambulatory or noncritical patient.

Utilities are the basis of our continued operation in the hospital plant. There is not one department or one member of the staff of the hospital that would not be directly affected from the failure of one or more of the utilities discussed. Technical considerations should be considered at the outset, particularly in design of new hospitals. In existing hospital plants, careful scrutiny should be given these by the engineer and the administrator. If the services of consulting engineers are required, there should be no hesitation in

calling in such experts to discuss plans, make whatever changes, and provide whatever emergency equipment would be necessary to maintain the operation of your physical plant, and continue to give patient care on as near normal a basis as can be expected under such circumstances.

Even though most of the population of any city understands and are willing to take the required precautions necessary during an enemy attack or other catastrophes, a well-thought-out plan for caring for the casualties within the hospital necessitating continuance of these utilities should help relieve disaster of some of its grim aftermath. The hospital engineer can help with proper planning of such technical considerations as set forth. Surveys of existing and prospective emergency hospitals, and recommendations for emergency stations are items that might well come within the jurisdiction of the engineer, and should possibly be proposed by him and carried out under his supervision. The engineer should consider the required steps that must be taken to insure the smoothest possible functioning of the hospital plant under stress of disaster.

DISASTER PLANNING FOR THE HOSPITAL ENGINEER

Disaster planning is a complex and changing procedure that must be well planned, taking into account the hospital's resources of equipment and manpower

Charles W. Barton

The first consideration in disaster planning for the hospital engineer should be: How will the disaster affect the hospital's physical plant? If all utilities are operational, there are certainly fewer problems, for the operational plan can go into effect immediately. Then, except for a stepped-up tempo of activities, life for the engineer will remain much the same. If part of the facilities have been damaged or destroyed, however, the problems will increase, and well-laid operational plans may be useless unless the engineer has done plenty of advanced planning.

Auxiliary Water Sources

Among the things that the engineer must consider in disaster planning is the water supply. A pure water supply is a service that is taken for granted. Time has dimmed the image of hand-pumped water in community life. Now we turn a faucet and clear refreshing water is there for the taking. Normally, we do not have to worry about contamination, but this can change very quickly when disaster occurs.

What can happen to the water supply? The source can become unusable. The main pumping station can break down in spite of all modern devices to prevent it. The main that serves the hospital can be out of use for a period longer than the engineer or the water company wants it to be. The last cause of interrupted water service can be handled more easily than the first two—unless the hospital has only one tap to a main. The engineer should check the possibility of obtaining another connection to the main grid system as an alternate source of supply for the hospital.

The first two causes of water shortage present an entirely different problem because what is really needed is a secondary supply. Where is it to come

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from? The engineer should make inquiry. Is there a well nearby? If so, how can the water be delivered to the hospital? Is the well close enough so that by using extra pipe and a pump it can be supplied to the hospital? If this arrangement is impossible, hauling water by transport to the hospital may be the only other solution. Each solution seems to add another problem and this one is no different. If water has to be hauled in, the hospital is confronted with a storage problem. How will planning take care of this problem? Further, how will the water be transferred from the tank wagon to the storage facilities? By use of an existing pump? Good. But have arrangements been made to connect the suction line to the water tank wagon?

If a secondary source of water is used it must be properly chlorinated, so the engineer should include a chlorinator in his plans. It doesn't have to be a gas feeder, for a hypochlorinator will do the job at a lower total cost. Hypochlorite will be used at about 1 ounce per 1,000 gallons, which will provide about 5 ppm. residual chlorine. This is considerably more than is required for a normal treated water supply. The Department of Health, Education, and Welfare recommends a dose of 10 ppm. for water from undeveloped sources. These high dosages are necessary because organic matter and other material in the water will exhaust the chlorine before it has acted on bacteria. Overchlorinating will do no harm; hypochlorite will have been wasted, but the odor and taste of the water will keep down consumption. If supplementary treatment is necessary, be sure that the sterilizing agent is applied on the suction side of the pump because this will assure thorough mixing of the water and the agent.

One important item is water consumption. Knowing the demands for water in the various hospital departments, particularly the laundry and kitchen, the engineer must determine whether the secondary source of water will take care of them. If it won't, usage in some areas will have to be reduced or eliminated completely. Without conservation, somebody will go without water unless an additional source is found.

Sewage Disposal

It has been said that the sewerage system is just an extension of the water distribution system. If the use of water is curtailed, certainly some steps must be taken to reduce the quantity of waste products to be handled by the water carrier. The accumulation of wastes and failure to handle them adequately will result in (1) odors, (2) increased vermin and fly population, and (3) increased possibility of reinfection and cross infection.

It is imperative, then, that every effort be made to remove the wastes from the site. It is to be hoped that an early return of water service will keep this problem to a minimum. Until such time as the hospital can return to

normal operation, human wastes will have to be removed. The questions are: How and where? There are three possible courses of action:

1. If the engineer or purchasing agent can find a commercial scavenger to handle the waste problem, all that remains is to transport the wastes to the loading dock. Of course, the engineer will be faced with severe problems in odor control and fly control from the beginning. Containers will have to be kept meticulously clean, which is no small task when water is at a premium.

2. There is the possibility that the engineer can use the nearest sewerage manhole as a disposal point, flushing the manhole periodically as water becomes available.

3. In some cases, building a leaching basin on the hospital grounds is possible. Before any move is made, however, it will be necessary to contact the local health authorities to find out what their plans are and what they will permit in an emergency. To be ready for any eventuality, be sure to have on hand disinfectants in sufficient quantities to keep down odors, flies, and vermin.

The discussion so far has been concerned with the disposal of human wastes that may be carried away by water, but there are other wastes commonly referred to as rubbish, which the community or commercial scavenger usually removes. If this is impossible under emergency conditions, then it will be necessary to make arrangements with the local health authorities to burn combustible trash on the hospital grounds, or take it to a designated dumping area. It is well to assume that, under emergency conditions, collections will be at irregular intervals, so extreme care must be exercised by the engineer in the collection and storage of this type of waste.

Electrical Service

Since all of the services tie into each other, it is difficult to talk about one without referring to another. Everyday life in Western countries is so dependent on the use of electric power that without electricity, ordinary living comes to an abrupt stop. Life around a hospital is no different. When the power supply fails, the telephone system automatically functions on batteries, lights flash in various places, bells ring in the equipment room, and the switchboard operator is flooded with questions she can't answer. What happened? How long will the power be off? These questions, and many others so take her time that she can hardly manage to telephone the engineer to report the failure.

The question now is: What has been done in advance to meet this situation? Of course, the power outage can be the result of any one of many things. At one hospital an electric storm played havoc with the substation that served the hospital. Because of some utility problem in traffic resulting from the same storm, no power was available for several hours. On another occasion, a contractor working for the hospital repeatedly and accidentally pulled up cable and so deprived the hospital of electrical service without notice. The

contractor paid for repairing the lines, but that in no way compensated for the loss of power at critical points, or the emotional disturbance experienced by patients and operating personnel alike. In the first instance, there was no damage to the hospital's facilities; it was just a matter of starting standby generators and using battery-operated lights. In the second case, the hospital could have provided power had it had a sectionalized circuit, but there was no way to cut out the damaged section and feed back to supply power to the rest of the buildings.

The engineer should take a long look at his utility plans and decide what he has. If he can't tell from the information available, then in all fairness to himself and the hospital, he should trace out what he finds in place. It won't be easy and it won't be done in 2 or 3 days, but he should put it on paper so that everybody who should know may understand it, and he should keep the information where all concerned may have access to it.

Disaster Utility Plans

Speaking of utility plans, the engineer should give some thought to a duplicate set or two, placed in containers and appropriately marked "Utility plans to be used in case of disaster." It is recommended that they be placed in basements at widely separated points. These plans should not be cached and left to gather mold. As changes are made on the regular set of plans, the engineer should enter the same changes on the disaster set or sets.

Upon completion of an up-to-date set of plans, he should study them thoroughly and ask the following questions. "Do I have sectionalized circuits so that if one area is out, I can backfeed to supply most of the hospital with power?" If he can't, he ought to make a study and prepare cost estimates and justifications to present to the administrator. Are principal valves indicated and properly marked? When was the last time he checked circuit loads? Did he wait until he had trouble with fuses and breakers? Are the loads balanced? Without this information, how can he expect to come through an emergency without causing another one within the one he already has? How careful is he in checking the electrical characteristics of replacement equipment? It is a rule in Veterans Administration hospitals that the engineer officer must certify that there are utilities available for any new piece of equipment (initial or replacement).

Standby Power

Next, what about standby power? When the power goes off, the ventilating and air-conditioning units stop; the boiler plant blowers and pumps stop; the morgue can't hold proper temperatures; food begins to spoil, and generally someone is caught between floors in an elevator. In addition, the operating room, laboratories, and X-ray and other services are affected.

The popular concept of standby power not long ago was to provide an emergency standby generator for the operating room only. It was large enough to handle emergency lighting and a few outlets. After installation of this equipment, it was promptly forgotten and everyone went about smugly

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confident that all was right with the world. Today, we think differently about standby power. Because other hospital activities must continue along with those in the operating room, standby generators are needed for more than just emergency lighting. In multistoried buildings, standby power must be provided to operate at least one elevator. The planning for standby power should include sufficient capacity for one or two dumbwaiters and for strategically located outlets to service portable X-ray equipment, electrically operated stills and sterilizers, and refrigerators storing antibiotics and blood.

Listing Electrical Needs

Now is the time for the engineer to make a complete study of the hospital's electrical needs, listing the areas requiring electricity and pinpointing particular needs. He can then determine the essential areas that will need standby power and prepare plans to meet these needs. He should not be stingy about these generators, but should "oversize" them because the price difference is negligible between a generator that will barely do the job and one that will not only adequately handle the present load but also will have at least a small reserve for future loads. When dollar consciousness on the part of administration looms large, it may be difficult to sell this idea, but the engineer should point out that (1) a hospital does not buy a generator every day and with proper care it can last for years, and (2) the modern demands of hospital activities increase the electric load almost daily. Some of these extra loads will demand standby power too, and generators that can carry only today's loads will never satisfy tomorrow's demands. Somebody will

BATTERY SELECTION FACTORS

1. Do you want the dry-type battery that you can throw away when it runs down?
2. Do you want the wet-type battery that lasts for years, but requires a service check weekly?
3. Do you want four-lamp or six-lamp units that give a considerable amount of light for a short time, or do you want one-lamp units that will last for several hours? Most sales are of two-lamp units that provide usable light for about 4 hours.
4. Wet batteries are more expensive initially and cost more to maintain.
5. Wet batteries are not as movable because some care must be exercised in handling them.
6. Wet batteries, however, if serviced regularly are purchased only once.
7. Wet batteries can be kept fully charged by use of a trickle charger, and then are very reliable.

be going without power unless these plans for standby power are carefully made and executed.

Whether to install automatic transfer switches is something each engineer will have to decide. Automatic transfer switches are expensive, but without them the uncertainties of human reactions to emergencies will have to be taken into account.

In his rush to get his electrical house in order, the engineer must not forget to plan and prepare an emergency kit. It should include such basic items as rubber and leather glove sets, climbers for pole lines, and hot sticks for pulling "cutouts." In addition to these, a tool for forcing elevator doors, etc., if the necessity arises, is indispensable. An assortment of wrenches, screwdrivers, and pliers, all in first-class condition, is essential. One point to remember about gloves is, be sure they are inspected every 30 days to insure that the rubber gloves are properly powdered and the complete set of gloves has not developed cracks or breaks. The local power company will test gloves for resistance, and usually at no charge. If an emergency occurs, the engineer will need every man that he can round up, so he should avoid losing the service of anyone because he has failed to keep all tools and equipment in the assigned places and in working order.

Emergency Lights

Every hospital area wants light, but lighting can be taken care of by means other than live electric circuits. Battery-operated emergency lights may be used for certain areas. The engineer will have a choice between dry-type and wet-type batteries. He should take time to make his decision, for each has its advantages and disadvantages. Since there is a wide difference between battery-operated lamps, some items to be considered in arriving at a decision are listed on the preceding page.

Whether a wet or dry battery-operated electric light unit is purchased, there are some desirable features to look for. They include:

- Push buttons for reading a built-in voltmeter.
- Test switches.
- Sealed beam lights or lamps.
- Indicator lights to show that the circuit is in service.
- An automatic switch to cut in batteries when power fails and to cut out batteries when the power is returned to the circuit.
- A case that is easy to open.
- Wall-mount brackets (some units come with and some come without these brackets. Generally it is cheaper in the long run to have the brackets already attached than to try to spot weld them later with hospital labor).

Someone will ask, "Where are we going to put these battery-operated lights?" "How many are we going to need?" The answer to both questions is: A study must be made. Study the layout of the hospital and determine

where lights are needed; add up the number needed for the selected areas; determine the cost, and compare the cost with what the budget will bear. No two hospitals' requirements will be alike. The amount of standby power will exercise a tremendous influence on emergency lamp needs.

The engineer also should be sure that his budget includes money for replacement batteries in quantities that will assure lights when needed. Depending on the quality of the batteries, they may begin to show evidence of weakening after about 90 days. They should be checked on the regular maintenance schedule to keep up the stock level. Any lamp unit with automatic switches will turn the lights on every time there is a blown fuse, and it will keep them on until the circuit is again operative. Such action affects the life of the batteries. It is poor practice to turn the battery-operated lights off during the replacement of fuses. Too often the lights are turned off and forgotten; the forgotten "off" switch won't give light when needed. Maintenance of these lights is time consuming but it cannot be left to a casual maintenance procedure, if the engineer expects satisfactory operation in an emergency.

In other areas, the old-fashioned kerosene lantern can throw its pale yellow light to a good advantage. Its use will prevent a lot of stumbling, falling, and injuries. Nurses and aids can use hand flashlights or railroad-type electric lanterns.

AREAS WHERE EMERGENCY LAMPS SHOULD BE PLACED

1. Telephone switchboard.
2. Elevator lobbies on all floors, and the basement.
3. Ward corridors—two units. The number, of course, depends on the layout.
4. Stairwells not hooked up to standby generators—single-lamp units.
5. Penthouses and service rooms. These penthouses are the elevator and machinery penthouses.
6. Boiler plant. Several should be focused on gages, control boards, valves, and traveled areas of the plant. It is again assumed that there is no standby generator for the boiler plant.
7. Pharmacy. This area should have standby power because of the necessary refrigeration. In any case, don't expect the pharmacist to fill prescriptions in the dark, or by the light of paper matches.
8. Admitting and triage areas.
9. Ambulance areas.

Refrigeration Service

When the power is gone, the refrigeration is gone too. The problem of waste disposal begins to build up as food begins to spoil. What is the answer? In a communitywide disaster, it does no good to contact the local food locker companies; they have more refrigeration without power than the hospital does. Where will the engineer obtain enough ice to help? The day of the icehouse with tons of ice under a pile of sawdust has long since gone. Even though he could get ice, where would the engineer put it? Modern refrigeration is designed to store food; there is no room for a chilling agent. Again, he must turn to a standby generator for power to carry on with refrigeration.

If the hospital has a garage, how will gasoline be pumped for hospital vehicles and the operating room generator? The problem can be solved by stripping the cover from the pump, moving one of the medium-size, park-type lawn mowers into position and fitting a fairly long V-belt from the pump to the mower to operate the pump.

Boiler Plant Needs

The boiler plant is the heart of the hospital and its steam is an all-important item of hospital operation. How is the boiler affected in a disaster? What must the engineer look forward to in his planning?

If gas is the plant fuel and the disaster has not affected the gas distribution system, there is little to be concerned about. However, if it is necessary to switch to oil, it is well to look at the oil system. Is the engineer dependent on electricity to keep the oil at a normal feeding temperature? If so, planning should provide steam coils to keep the oil at proper temperature. This is essential when there is no standby power for the boiler plant. The engineer should check the type of pump he has for pumping oil from the tanks. If it is a steam pump, he has one less worry; if it is electric, some auxiliary power will be needed.

Coal as a fuel poses two problems. One is the grading of the coal. At one hospital, specifications called for 30 percent fines. The unit cost of coal was less, but its firing problems more than offset the lower unit fuel cost. During a disaster, the engineer can ill afford the luxury of cheap coal. The other problem is the reserve supply. Veterans Administration regulations require a 60-day reserve supply based on the maximum consumption-day. That is a big pile of coal, but none too big if a strike or bad weather cuts off the supply for an extended period.

Regardless of the type of fuel used, if there is no power the condensate return must be dumped to the drains unless all return is by gravity. With loss of vacuum and no condensate return pumps, the engineer has no other choice. Planning must incorporate a procedure for this dumping action. Loss of condensate return increases the problem of makeup water, especially if water has become a critical item. Even with a sufficient water supply, an added load will fall on the preheater. The woes of the engineer will be

compounded by vacuum loss because the remote wards and buildings will have little or no steam.

This paper has been mainly concerned with the utilities that normally take up most of the engineer's waking hours, but he has another responsibility that he may easily overlook. Undoubtedly the hospital staff has decided what space can be made available for additional patients and emergency needs. It is well to look this space over to make sure that changes have not been made that render it unacceptable for the proposed use. Current space utilization plans, assuming they exist, should show the engineer what he needs to know about an area, but the value of a personal inspection cannot be surpassed. There is little doubt in a disaster that moving of materials and epuipment will take place. Will these moves cause overloading of any area? Certainly we do things in an emergency which we wouldn't do normally, but we must know what the floors can carry safely to prevent a disaster within a disaster. This knowledge of allowable loads is particularly important in the case of frame joists or frame construction. Time, weather conditions, and vermin can change the physical characteristics of frame construction. It is important, therefore, to inspect frame construction periodically to insure that dry rot or termites have not weakened the structure.

Helicopter Service

Helicopter airlifts are often used to transport injured individuals, and some hospitals may be in a position to use this service. If the engineer believes the hospital is capable of handling helicopter service, he should look into the total problem carefully. If the hospital has a large flat roof area that would permit a helicopter landing, a careful study of the structural details of the roof must be made to be sure the structural members can take the additional load. If it is determined that a helicopter can land on the roof, how will the patients be brought from or taken to the lower floors? Is access to the roof through scuttle holes, or does a stairway give free and easy access to the roof? The prevailing wind and its velocity play a big role in helicopter landings in limited areas.

Would the hospital lawn be better as a landing area for helicopters? The fact that the lawn area is large enough does not mean that it would be suitable, for the landscaping and tree locations will have to be taken into account. In any event, the study should be made in close cooperation with local authorities, a private helicopter service, and the military services that are experimenting with helicopter units for medical evacuation. If the idea of helicopter services looks feasible, the engineer should have most of the answers before making recommendations for its use.

Crowd and Traffic Control

How should the engineer plan to handle the crowds that can be expected around a hospital in a disaster? In addition to the injured, excited or hysterical relatives and friends will add to traffic problems and overall confusion. Hospital personnel know where the injured are going, but not so

with the others. Disaster plans should provide a place for them to go, preferably to a building apart from the main portion of the hospital. Signs will help direct them, but are not enough. Someone will be needed to help direct them to the areas that have been provided for them.

Planning should include close cooperation with the local police. The engineer should determine how much help can be expected, regardless of the magnitude of the disaster, and should decide, in cooperation with the police, what his limitations are. It is understood that no attempt would be made to handle traffic except within the limits of the hospital grounds. If he must augment the service offered by the police, it stands to reason that some special training is required. What arrangements can be made for instruction to selected employees? If employees are going to act as auxiliary police, then provision must be made to identify them—an armband, a badge, or an identifying streamer pinned to the shirt or coat.

Arranging for hospital personnel to look after traffic will not completely solve the traffic problem. Present-day needs for parking and traffic control within the hospital grounds are a good basis for saying that additional steps will have to be taken in disaster planning. Studies must be made of the entrances, roads and parking areas, and their relation to one another, to determine how they can best be used in an emergency. The plan must provide for ready access to emergency or ambulance unloading docks and ramps. Routing to eliminate two-way traffic with its attendant confusion will help. Supplies may require open storage temporarily because there is no additional space under cover. This area must be roped off and traffic kept away from it. Proper security measures must be inaugurated to prevent pilferage.

The engineer's disaster plan should also include identification cards for employees showing that they are hospital employees, and needed, in case of disaster. Essential in time of disaster, they should not be kept from passing through police lines. Periodic checks should be made to be sure they are carrying their cards and that they are kept in good condition.

Disaster Training

Part of the planning should incorporate training for all employees in as many phases of the work as possible. No one can be sure who the best man will be when trouble starts. The man banked on most may be fighting his way back to the hospital through police lines, or bucking bumper-to-bumper traffic. The available personnel can't wait for detailed instructions. The situation calls for immediate action—not any action, but logical planned action.

Now, the engineer should prepare a simple operational plan to go into effect as soon as the alert is sounded. The plan should provide for setting up lines of authority, determining where groups will assemble, and deciding to whom they will report. The composition of teams and their duties

DISASTER-PLANNING CHECK LIST

Many subjects have been discussed in this paper, so here are some check points that the engineer should include in his planning.

1. Close cooperation with all of the hospital's operating units.
2. Close liaison with local, municipal, county, and Federal authorities.
3. Preparation of up-to-date utility and space utilization plans.
4. Studies of electrical needs to determine the quantity of standby power required to keep the physic l plant in operation.
5. Identification of principal valves and switches to be sure there is no error in operation.
6. Scheduling of inspections and maintenance of all emergency equipment, and periodic operation to make sure it works.
7. Training of engineering personnel thoroughly in their emergency duties in addition to normal operating duties.

should be listed in a general way. Maintenance teams to cut and reroute utilities as needed, for example, can be made up of a plumber and an electrician. A demolition team could be composed of a mechanic and laborers who can use cutting torches. A rescue squad could be picked from the labor group and the grounds maintenance group. The actual selection of teams cannot be made until it is known who is available and what type of work is needed. This plan cannot be restrictive, but must allow freedom of selection and action.

Disaster planning is never finished. You cannot prepare a disaster plan and say, "This is it." Disaster planning is in a constant state of flux, changing with new ideas and new concepts. After having adjusted plans to meet new challenges, the engineer should ask "Am I ready?" Even if the answer is, "Yes," he should take another look to be sure.

DO YOU FEEL SECURE WITH YOUR EMERGENCY POWER SUPPLY?

Emergency power can take a number of forms
supply power in different quantities
cost a lot
cost a little
and be in varying degrees of effectiveness
depending upon what it was designed to do

H. S. Gillespie

By the time your new hospital is ready for business it may be well out of date. This is a disappointment to the board, the administrator, the donors, and others who have worked so long and hard to make the new plant the best and latest available.

This is not really anyone's fault because there is a long lag between the time that ideas are put into drawings and the time when the first patient is received. Many things happen during this time and sometimes they happen rapidly. In some areas, however, this movement is not so fast. The subject of this paper is one of the comparatively slower changing aspects—the emergency power supply of the hospital.

Source of Emergency Power

What is meant by emergency power supply? This is the source of power that will be utilized when the normal source is not available. It can take a number of forms, supply power in different quantities, cost a little or a lot, and be in varying degrees of effectiveness. Just what it can do will depend upon the original planning. In order to do this planning certain questions have to be answered.

In the new hospital it will have to be decided if the plan should provide emergency power during short-term outages or for complete destruction of all outside power sources. It should also be known how much power will be needed, what type, and how much it will cost, what type of fuel it will use,

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where it shall be housed, how powerful it should be, and what areas and equipment it is meant to serve.

The purpose of this paper is to discuss the sources of information on emergency power equipment in such a way as to provide guidance in answering these questions on the installation of emergency power equipment. This paper is written from the standpoint of the board or the administrator and not the engineer. It is presumed that the planner will consult the engineer on technical matters. It is not contemplated that this paper should substitute the need for the engineer; instead, like law, it is meant to point out that there is a time to consult the lawyer and engineer.

Texts which deal with hospitals and emergency power supplies are in some respects well out of date, while others are still fairly reasonable. Consider this statement, "* * * on account of its decided advantages over other systems, electricity has practically superseded all other forms of illumination in hospitals." (*1*)* This was written in 1913 and for the day it was authoritative. This did not deal with an emergency standby supply of power, but it did recognize the need for the most recent and effective means to provide good patient care.

In our generation we usually quote MacEachern. He contended that, "In large hospitals where the installation cost is warranted, an emergency generating unit should be a part of the hospital powerplant equipment." (*2*) So far as texts are concerned, there has been nothing new on emergency standby power power supplies for hospitals since MacEachern.

By far, the periodicals are the better source of information on this subject. For example, the texts have failed to consider one important phase of planning, that of complete or nearly complete disaster. This subject has been taken up by the periodicals and will no doubt be contained in texts of the future. For the most part, however, this material is based upon periodicals as shown in the bibliography, page 58.

L. A. Bello has said that there are three reasons for providing standby power and they are: human safety, economy, and convenience. (*3*) Mr. Bello is an architect and is writing in an architectural publication, yet his principles are equally applicable to a hospital as well as to any other place where the public gathers or business is conducted. Human safety is one of the prime considerations in the hospital. Economy is certainly a consideration when it is pointed out that some foods, medications, and bood would spoil without adequate refrigeration. It is certainly more convenient to read a medical chart in the light rather than darkness and easier to operate an iron lung with electricity than by hand. Through these principles Mr. Bello furnishes a basis for deciding whether or not emergency standby power should be provided.

The evolution of emergency power sources has run from dry-cell flashlights, to surgeon's headlights, to liquid storage batteries in the operating

*Bibliography for this article is on page 58.

room, to central storage batteries, to integrated battery and generator combinations. (*4*) Today there are three common sources of emergency power that are utilized by hospitals in varying combinations. These three are: Storage batteries, generators, and utility electric service. (*3*)

Utility Lines

Of these three sources of emergency power, which would be appropriate for use in a given hospital? MacEachern says that there should be two separate outside utility lines augmented by emergency generators. (*2*) Hogan says that a new hospital should be wired for two outside utility sources and a small standby source should be available for critical areas only. (*5*) In its publication on emergency electrical systems for hospitals in 1950, the American Hospital Association said that there should be an emergency source plus two independent powerlines. (*6*)

For a moment let us look at some experiences of power failures to see how useful two independent power sources from the outside can be. On August 17, 1959, 425 city blocks in Manhattan were without power for 13 hours. In this area there were six hospitals and none of them had sufficient emergency standby power nor a second outside utility source. Their problems were solved with the help of the fire and police departments as well as civil defense and local radio and TV stations. (*7*)

In El Dorado, Kans., a hospital had three independent outside utility sources and none of them was able to provide power when a tornado knocked them all out at once.(*8*) This is an exception? Yes, it is, but what of the future? The provision of two outside power supplies could handle, no doubt, any outage that might occur, but this is the atomic age and in a disaster such as war, 2 or 50 outside sources may be of no value at all. The purpose here has been to strengthen the point of providing internal standby power in addition to as many outside sources as may be desired or practical.

After it is determined that there will be emergency standby power in the hospital, it should be decided what type it will be. It was stated earlier that there are three types of emergency power supplies: Generators, batteries, and outside electric utilities. Since we have already dealt with the electric utilities, we can go on to the remaining two.

Generators and Batteries

N. L. Griffin has said that if only one internal emergency source is available, the generator is to be preferred over batteries. The primary reason for this is that the batteries must be recharged with electricity and in sustained periods of power shortage the batteries would deplete themselves. (*4*) This is not to say that generators should be used to the complete exclusion of batteries. When generators are used in an emergency, there is a momentary delay between the time of power shutoff and the time that the generator is ready to deliver its charge. This delay time could be critical

under certain conditions. To compensate for this, small battery sets can be utilized to go on instantaneously with a power failure. Generators in combination with batteries then, provide the best source of standby emergency power supply.

Supply and Demand

The next question to be answered is one of supply and demand. How much money can be supplied and what is the demand so far as emergency power coverage in a hospital is concerned? R. W. Walker, in his article, "How to Choose An Emergency Generator," has outlined a six-step procedure which appears to be quite useful at this juncture. The steps are as follows: (*9*)

1. Classify needs on an essential, desirable, and nonessential basis.
2. Determine the size needed.
3. Determine the type needed.
4. Obtain bids from vendors.
5. Make the installation.
6. Conduct recurring tests.

When classifying emergency power needs, much will depend upon local circumstances such as the type of hospital. But, it is obvious that there are certain areas which must be considered essential. The National Fire Protection Association has classified areas in the hospital which should be served by an emergency power supply. (*14*) The complete emergency system is called the protected continuity system and is divided into three parts; emergency electrical system, critical electrical system I, and critical electrical system II.

The emergency electrical system represents the immediate needs and refers to such functions as exit ways, signs and lights, alarm system, fire alerting systems, and certain surgical and obstetrical suite circuits.

The critical electrical system I requires automatic restoration of power as does the emergency electrical system and contains optional areas and functions. This group encompasses surgical and obstetrical recovery rooms, intensive nursing care units, infant nurseries, nurse's stations, dispensing pharmacies, emergency treatment rooms, blood bank areas, and central suction systems.

The critical electrical system II can be restored on a delayed basis, and it too contains options. Recommendations on this list include equipment required for the safety of major apparatus, lighting for rooms containing major apparatus, heating systems, elevators, central sterile supply, hot water generation, X-ray, laboratory, kitchen, laundry and refrigerated medical storage.

The above does not represent a complete list of functional areas as recommended by the National Fire Protection Association, but is abbreviated for

the purpose of illustration. The complete list is to be found in the NFPA publication No. 76, on this subject.

Walker's second step is to determine the size needed. He indicated that in existing hospitals a series of tests should be conducted on each electrical panel in the hospital, and ammeter readings should be taken in the main lines. Through this technique total power requirements as well as peak loads can be determined and heavy power drain areas located. After the readings are obtained they can be checked with the power company, State agencies, and power equipment dealers. Combining this knowledge with possible expansion plans can yield a valuable guide in determining the amount of emergency power that is needed.

Mr. Burke Frick, district engineer, Westinghouse Electric Corp., St. Louis, Mo., indicated much the same thing at the Tennessee Hospital Engineers Association district meeting in Memphis, Tenn. in August 1960. (*10*)

John A. Holbrook has given a rule of thumb which calls for about 1 kilowatt of emergency power per bed in a disaster. (*6*) This may be too high if other reports are considered. The average standby power per bed for the United States as a whole is 0.36 kilowatt. (*11*) This does not mean that 0.36 kilowatt per bed is ideal, but only that this is what now exists. Perhaps 1 kilowatt per bed would be better, yet, ammeter and panel readings might be a better guide for the specific situation.

The Emergency Generator

Consideration might also be given to full coverage with the emergency generator. In the 644-bed Buffalo General Hospital, Buffalo, N.Y., they installed a 750-kilowatt generator which is capable of supplying the entire power load of the hospital for an indefinite period. (*12*) This is sometimes more costly* but depending upon money available and local conditions, it may present a solution to the emergency power supply problem.

There are various types of generators with special features available today. The one feature which is commonly desirable is an automatic switchover system. Most automatic systems will start the emergency generator as soon as normal outside power sources reach a given minimum and will cut off automatically upon full restoration of that source.

Almost half of the existing standby generators in use in hospitals of the United States today are powered by gasoline. Diesel fuel generators make up about one-fourth, piped gas about 18 percent, and the remainder are driven by bottled gas, steam, or combinations of gasoline and gas. (*11*)

*Near 100 percent emergency electrical supply for new hospitals is proving to be economical because separate electrical distribution systems and equipment are not necessary. Labor and material costs for electrical systems have risen to the point where it has become more feasible, in most areas of the country, to consider near full capacity, with one electrical distribution system for normal and emergency power, based on design criteria for emergency generator capacity capable of handling 75 percent of maximum electrical demand, with the maximum demand being calculated at two-thirds of the total connected load.

—Daniel M. Roop, P.E., engineering editor.

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Available Fuel

It might be well to consider the availability of fuel in a disaster situation. It is still clear in many minds that gasoline was a premium item in World War II and that war was not fought on our own ground. In a true disaster, which fuel will be more easily available? Will the gaslines be blown out? Which fuel is the easiest to produce? Due to the nature of diesel fuel (it requires a minimum of refining), its comparative price, and the possibility of destruction of gaslines, diesel fuel appears to be the best choice.

To get bids from vendors is probably the easiest part of the system suggested by Walker. Here, however, is where much can go wrong. If the specifications are accurate and the power requirements have been surveyed skillfully, the vendor will be able to clearly state his price. If, on the other hand, the survey phase was slipshod, the hospital could find itself in serious trouble through power shortages, inadequate wiring, insufficient coverage, and excessive costs. Clearly, this is the place for the engineer to be fully utilized.

Installation, as the fifth step of the Walker system, would not seem to be a part of the process. It is, however, that in choosing the specific generator the agreement with the vendor could include the installation. Preparation for the installation, that is, the physical construction of flooring, special supports, and sound-proofing materials can also be brought into the system through the vendor acting as adviser to the local engineer. In short, the installation of the equipment is a part of the choice in that the contract should call for this service from the vendor.

Walker names the sixth step in choosing a generator as recurring tests. It would seem evident that there is not much question about the necessity of recurring tests of emergency equipment, but unless the contract requires the vendor to conduct the tests, I would have to discard it as a part of the process of choosing an emergency generator.

To get a good perspective of what exists in American hospitals so far as emergency power supplies are concerned, the reader should consult an American Hospital Association survey which was conducted in 1959. At that time the AHA conducted a survey of all 6,786 hospitals listed in the Guide Issue of Hospitals, J.A.H.A., August 1, 1959. The purpose was to determine how many hospitals in the United States have standby generators, and to what extent do standby generators meet hospital electric power needs. It was shown that about 66 percent of those hospitals reporting (80 percent answered the survey) had some type of standby facilities. (*11*)

To get a good perspective of what might exist in the future, the reader is invited to use his imagination.

Conclusion

Present textbook knowledge is not very valuable to us in discussing emergency standby power for hospitals. The current literature provides almost

all of the written information that is available to the planner. Other sources could and should be consulted if a project in this area becomes a reality. Some of these sources are: Architects, hospital engineers, vendors, those who have done this before, public utility companies, and specialized consulting firms.

There are two ways of viewing an emergency, either it will or it will not happen. If we choose to think that an emergency will never occur then it is a waste of money to install emergency equipment—for that matter, to construct the hospital at all. Obviously this is ridiculous. We accept the fact that an emergency of some type will occur by our very planning. It may be a blown fuse, a broken powerline, a tornado, or an atomic war, but it will come in some form. In any case, it is almost safe to presume that another general war will result in destruction on our own home grounds. This will cause our fire, police, and civil defense facilities to be fully occupied. Under these conditions, how effective will be the hospital that has inadequate emergency power of its own?

For true disaster purposes the source of emergency standby power in a hospital is of real concern and if we are involved in another world war, outside sources of electric power will no doubt be useless. The solutions to problems that will have to be faced under those circumstances are no more than good guesses at this point because we have never been faced with this experience. The best source of knowledge in this matter is in Europe under wartime conditions, and to the best of this writer's knowledge, nothing can be found in American publications which will shed light upon the subject of this paper. Inasmuch as no information seems to be available, a study of wartime European hospitals under bombing and destruction would be useful. This need could be satisfied by some person who is currently on the European scene. This individual could conduct a study of wartime European hospitals and how they solved their emergency power supply problems. Such a survey or study could make a real contribution to the future well-being of American hospitals.

GUIDELINES FOR INSTALLATION OF EMERGENCY ELECTRICAL SYSTEMS IN HOSPITALS*

The purpose of these guidelines is to present to hospital administrators and to design and operating engineers the need for emergency electrical systems in hospitals and to suggest how such systems may be reliably yet economically provided. The discussion seeks, at the layman's level, to propose desired performance goals and logical alternatives. It postulates principles and ideas that every hospital should consider if it is to provide uninterrupted health care to the community.

Definition of an emergency electrical system. The emergency electrical system is composed of selected loads without which the hospital could not continue to provide essential patient care. These are supplied by special electrical circuits and fed through automatically functioning switchgear that, when normal sources fail, is powered by a quickly and consistently available source of electrical energy. Systems of varying complexity are possible, consistent with the vulnerability and mission of the hospital. The system chosen should provide reliability, flexibility, and simplicity.

These guidelines should not be considered a complete source of information on this complex subject. They seek rather to give an overview of the subject and to offer a variety of suggestions, ranging from design tips to maintenance reminders, that might not be available from other sources. The guidelines will at times consider aspects of the entire hospital electrical system, since the emergency system is necessarily related to it. They further suggest several references that should prove helpful. It is recommended that, having considered the guidelines, each hospital:

- Review its electrical services for reliability and adequacy of source and wiring, and take any action indicated.
- Plan the generating plant and electrical systems, whether in new facilities or in alterations to existing systems, to meet both present and predicted needs of the hospital.
- Seek competent engineering assistance in designing or altering electrical systems to provide alternate service, improve reliability, and protect essential services to patients.

A number of disciplines should be involved at this stage. Not only must electrical circuits be designed; in addition, the generator plant must be carefully chosen, the foundation designed to withstand vibration, and operational features considered.

Need for emergency electrical systems. There is little question among hospital people today as to the necessity for provision of some standby power.

*These Guidelines—A revision of the statement, *Recommendations for Installation of Emergency Electrical Systems in Hospitals*, approved by the American Hospital Association, Dec. 9, 1950—were approved by the Association, Nov. 17–18, 1966. They suggest principles for reliability, sources of emergency power, areas to be covered by hospital emergency systems, arrangement of circuitry, and maintenance considerations, as well as a list of references on emergency systems in hospitals.

Hospitals may experience interruptions for a number of reasons, including: tripping or blowing out of circuits due to overload; local transformer of substation failures; downing of wires by storms or floods; fires in the area or even in the hospital; and major, widespread outages, however infrequent. In many cases these interruptions are tolerable, especially for short periods. Yet each hospital has functions, equipment or areas that cannot tolerate interruptions of more than 30 seconds, a minute or possibly five minutes, without substantial detriment to patient care. Certainly other portions of the hospital job can be carried on without power, or curtailed without harm, but these are essential.

It is important to note that failures may be internal as well as external—thus protection requires more than simple installation of a generator. An emergency system consistent with the entire electrical distribution system, designed by a competent and skilled engineer and maintained by experienced staff, is the goal to be sought.

The American Hospital Association recognizes that the circumstances of individual hospitals vary widely; for example, there are great differences in the missions of hospitals, and differences in the demonstrated reliability of the local utility company and in that of the hospital's own system. It further recognizes that existing hospitals have a more difficult problem than those in the design stage, since alteration of existing electrical systems may be complex, difficult, and expensive. In some cases the most desirable system may be attainable only in stages, as remodeling projects are undertaken; less desirable means may have to be accepted in the interim. In any case, however, careful consideration of the problem is urged.

Principles for reliability

Reliability of the emergency system and of the entire electrical system will be enhanced by observation of the following principles:

Simplicity—Keep system operation as simple and straightforward as possible.

Quality—Install only high-performance, high-quality equipment.

Capacity—Avoid overloading the system or any of its parts.

Expandability—In view of rapid growth of hospital loads, provide extra capacity initially, or design to allow its provision when needed later.

Compatibility—Be sure the emergency system complements the hospital's master plan and its normal system, and matches the electrical loads it must serve. Seek components or "packages" that are integrated and efficient.

Flexibility—Combine automatic restoration of power to emergency loads with a method of limited manual connection of certain key loads as a given situation may require.

Designer competence—Select an engineer who is competent and experienced in this complex field to design the system. This is particularly important if economy, reliability, and compatibility are to be achieved.

Designer freedom—Give the design engineer freedom to provide the best possible system, using new concepts and products.

Priority—Place only truly emergency loads, as defined above, on the highly protected circuit(s).

Balance—Seek a system with a degree of complexity that will neither encourage overloading nor cause confusion.

Documentation—Post operating procedures for testing and for transfer of loads. Maintain current as-built drawings of the entire electrical distribution system. Record testing dates and results.

Testing—Test frequently to ensure that the system and its users will perform satisfactorily during actual emergencies. Record testing dates and results.

Maintenance—Keep generation equipment, switchgear, relays, transformers and circuits in good repair. Since many of these items will be on circuits used around the clock, provide for bypassing to allow regular maintenance without interrupting service.

Surveillance—Inspect the system regularly (at least monthly) to detect faulty equipment and overloads before they become critical. Install metering devices at key points.

Sources of emergency power

The first requisite for an emergency system is some alternate to normal power supply source(s). An on-site generator operated by a prime mover is recommended as the optimum source of emergency electrical energy. The unit's size should be adequate to supply all estimated current demand for the areas to be covered. Fuel storage capacity should be sufficient for at least 24-hour operation, and should be supplemented by an arrangement with local armed forces, civil defense, or similar facilities for supplementation in case of need. (It may be impossible to obtain fuel from normal sources during area outages, when electric fuel pumps are not working.)

It is not the intent of these recommendations to discourage use of on-site generators or prime movers for other than standby power uses. Dual use of this equipment is logical if additional capacity or multiple units can thereby be justified.

It is suggested that an inplant electrical generating plant be selected on the basis of the following criteria:

Dependability
Low lag time
Ease of maintenance
Intermittent operation acceptability
Fuel-storage characteristics
Availability of fuel during emergency
Cost

Further guidance on how these criteria may be met is available in the references listed at the end of this document.

(Note: It is desirable for increased reliability and continuity that the hospital also be supplied by two independent power lines deriving their power from absolutely separate sources, with independent service lines located and installed so as to minimize the likelihood of simultaneous failure of both

services because of storms and major catastrophies. These services should be connected in such a manner as to pick up the load automatically and so arranged that the load of the emergency electrical system will not be transferred to the generator set if either of the central station-fed services is energized.)

Storage batteries are sometimes used as a source of emergency power. They may, for example, be used to supply lighting for surgical suites, areas that could be evacuated during prolonged outages, or exitways. As an interim measure pending remodeling, unit battery systems might be used to supply lighting to any part of this hospital. However, although helpful because they provide continuity of power to critical areas (by eliminating the 10- to 30-second delay involved in generator start-up), batteries are inadequate as the hospital's only source of emergency power. They will supply current for only a limited period without recharging, a problem in a protracted emergency. They supply only direct current, whereas many hospital loads require alternating currents. Even if used with static inverters, they are expensive sources of power for heavy motor loads or extensive fluorescent lighting demands, and like other sources, they require careful maintenance. For all these reasons, batteries should be used only as an interim measure or as a supplementary source of emergency power.

(Note: Batteries, if installed should be inspected at least monthly since they will eventually deteriorate.)

Areas to be covered by the emergency system

In some cases hospitals may provide enough standby power to cover their entire load, but a lesser capacity is usually installed, necessitating careful selection of loads to be covered. Since it is very easy to miss important areas or items, the following list suggests those that should be included in the system. The list is not intended to be inflexible; other loads may be added and some may be dropped after careful study of the specific situation. The total load connected (best determined by meter measurement of each load) should not, of course, exceed the capacity of the generating plant.

A. Alarm and communication systems
   1. Fire and security alerting systems
   2. Telephone equipment (e.g., PBX)
   3. Nurses' call and house paging systems
   4. Mechanical-electrical equipment safety systems
   5. Piped gas system alarms
   6. Ground detector alarms
   7. Other essential warning systems (refrigerator alarms for blood bank, pharmacy, etc.)

B. Corridor, stairway, and exit lighting, and exit signs

C. One maximum-rise elevator in each building housing patients

D. Operating, delivery, and emergency rooms (illumination, view boxes, wall receptacles, mechanical ventilation, and suction)

E. Labor rooms (illumination only)

F. Newborn and premature nurseries (illumination and wall receptacles)

G. Other patient areas (illumination and wall receptacles only, unless otherwise noted)
   1. Intensive care units
   2. Recovery rooms
   3. Coronary care units
   4. Communicable disease area (polio respirator outlet or other specialized equipment)
   5. Psychiatric patient areas (illumination only)
   6. Nurses' stations, including medication areas (illumination only)
   7. Corridor outlets for special patient needs (e.g., portable X-ray, monitoring equipment, etc.) at 50- to 100-foot intervals, marked for emergency use

H. Power plant (equipment such as boilers, pumps, and controls necessary for heating and sterilization; electric heaters in key areas if hospital is electrically heated)

I. Major mechanical and electrical maintenance spaces (illumination only)

J. Laboratory and pharmacy (illumination and refrigeration)

K. Specialized equipment (blood, tissue, and bone banks; research laboratory specimens; sterilizer controls)

L. Civil defense plan needs

M. Other loads as required to meet local needs

Arrangement of circuitry

As stated previously, protection of critical functions requires more than simple installation of a standby generator. The hospital's internal circuitry plays a significant role in provision of reliable power.

Wiring should be arranged so that, in the event of failure of the normal power source(s), the applicable portion of the hospital's load will be transferred automatically to the standby source. Protective devices should be provided to prevent overcurrent damage or interconnection of the normal and standby power sources. Since all current flows through the main transfer switch(es), particular attention should be given to protection against total loss of power through switch failure.

Most, if not all, hospitals will be required by local code to segregate an "emergency circuit" from all other wiring. The intent of this requirement is to protect key loads from loss of power, even when normal distribution systems fail internally. The proper course is to place on this circuit all those loads, and only those, that are truly of an emergency nature. In most types of public places, the function of the emergency system is to get people out—to provide exitway lighting. In hospitals, however, other needs are paramount, consistent with the hospital's need to stay in operation. Applying this principle, administration should determine which loads, in the particular hospital, are most critical. Then, to the extent permitted by design conditions, these loads should be included on the segregated emergency circuit.

The problem of providing reliable emergency power to existing hospitals is a complex one. The cost of rewiring existing structures, except during reno-

vation or remodeling projects, is very high. Several possibilities might, therefore, be considered in light of the characteristics of the specific installation:

- It may be more economical to install a generator plant capable of carrying a large portion of the hospital's load than to rewire the entire building. It must be remembered, however, that the plant should be oversized or expandable to allow for future electrical demand, which studies show to be increasing in hospitals at a rate of 5 to 10 percent per year.
- In many cases it is possible, even with existing wiring, to limit electrical load to the capacity of the standby power source by "dumping," either automatically or manually, heavy motor or even lighting loads that are not essential to emergency operation (such as comfort air-conditioning equipment). Automatic dumping requires provision of the proper relays in the circuits selected. Entire circuits of specific motor loads can be excluded in this way.
- It may be possible and desirable to provide some flexibility as to load covered at any given time. It is helpful, for example, to switch power to each in turn of a bank of elevators, to bring them to the ground floor or to use them for various purposes. Similarly, it would be helpful to use for various priority loads (e.g., kitchens at mealtimes) generator capacity not already committed to critical loads. In this case, selective manual switching might be provided to feed power through the main panel to the desired load. Obviously such a capability requires careful planning and competent operation. Meters should be provided to prevent overloading and care should be taken to assure that such systems are carefully monitored and that some capacity is left to cover surges in demand.

Flexibility is a valid objective, but provision of flexibility should not be carried to the point where reliability of the emergency system is compromised.

Maintenance

Tests of the automatic switching devices, starting devices, and generator set in the emergency system should be conducted weekly under load. (Generator sets should always be at least partially loaded to prevent engine damage.) In addition, the peak connected load should be picked up periodically to ensure that generator capacity is still adequate and that hospital personnel are practiced in working with the system. Records should be kept of such tests and should include at least the following:

1. Date and time of test
2. Duration
3. Peak load noted
4. Temperature and oil pressure observed
5. Condition of starting batteries
6. Fuel-storage supply level

(Notes: Internal combustion engines, once started, should run at least 30 minutes to prevent engine damage and to restore full battery charge.

Hospital fuel tanks should be kept full, both to minimize contamination of fuel by condensation and because liquid fuels stored in the supplier's underground tanks may not be available during a power outage.)

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HOSPITAL DESIGN

NUCLEAR AGE HOSPITAL DESIGN

The Survival Complex is only one of the innovations at Southwest Texas Memorial Hospital

Charles U. Letourneau, M.D., and William D. Hamrick

With the breaking of ground for constructing of the Southwest Texas Methodist Hospital in San Antonio, Tex., which was signaled by the detonation of a mock atomic bomb, hospital design passed another milestone in the race to keep up with the developments in our modern society. This hospital renders existing designs obsolete and will, in all probability, become obsolete itself within 10 years, so rapidly do times and circumstances change.

The inclusion of the survival complex (see p. 30) in the hospital is only incidental to the intention of the governing body to provide the highest quality of patient care at the least possible cost to the patient. The new hospital is semiautomatic. As many automatic devices as possible were included to eliminate personnel wages which are presently the largest single item in the cost of hospital care.

The master plan calls for the construction of a 750-bed hospital to be affiliated with the medical school shortly to be built in San Antonio adjacent to the present hospital property. This building represents the initial phase of the plan. It provides for 175 beds plus supporting services and space for additional services to handle another 250 beds.

The design of the patient floors is a slight modification of the conventional two-corridor plan with each floor containing two nursing units of 25 beds each. Each floor includes a decentralized floor pantry containing an electronic radar cooker for fast reconstitution of meals so that a patient can be served with hot palatable food at any hour of the day or night. In addition, each

Charles U. Letourneau, M.D., consultant; William D. Hamrick, administrator, Southwest Texas Methodist Hospital, San Antonio, Tex.

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floor will be served by a rapid transit conveyor system linking the central service department with an automatic receiving station located between two nursing units. The conveyor could also be used for food service in an emergency but this will not be its main purpose. Rapid distribution will also be assured for smaller items by the use of the large-size automatic pneumatic tube system.

Patients will be able to look at television programs from their beds and a closed-circuit installation will also enable them to participate in prayers, religious services, and special programs which the hospital may wish to conduct from time to time.

Some experimentation will also be conducted with a two-way nurse-patient visual communication system which now exists in most hospitals. Patients can also visit with children and relatives via the closed system television monitor.

Television in patient rooms is no longer a luxury. It has been well established that patient calls for nurses are greatly reduced during the showing of a popular TV program. Moreover, patient morale is greatly elevated by the opportunity to maintain communication with the outside world instead of being oppressed by the feeling of isolation where there is no opportunity to see and hear favorite programs.

A touch of elegance has been provided in the maternity suite where each room is provided with a patio where mothers may visit each other and, in good weather, may actually dine out of doors in the best tradition of Parisian sidewalk cafes.

CONSTRUCTION DATA
For Southwest Texas Methodist Hospital, San Antonio

Architect: Phelps & Dewees & Simmons, A.I.A., San Antonio, Tex.
Associate Architect: Page, Southerland & Page, A.I.A., Austin, Tex.
Consultant: Charles U. Letourneau, M.D., Chicago, Ill.
Administrator: William D. Hamrick.
Contractor: Walsh & Burney.

Gross cubage	2,285,238
Gross square feet	175,049
Less—civil defense space	26,940
Net square feet—hospital facilities	148,109
Gross square feet per bed	1,000
Bed capacity	175
Construction contract (including group 1 equipment)	$4,433,200
Cost per square foot (gross square feet)	$25.32
Cost per cubic foot (gross cubage)	$1.94
Cost per bed (including non-hospital facilities)	$29,000

Disaster Features

Physicians will be paged via high-frequency radio receivers which will be tied in with the Federal Government licensed broadcasting station which the hospital will maintain. In the event of a disaster every physician within a 50-mile radius could be summoned in seconds wherever he might be. This will be tied in with the civil defense plan for the San Antonio area.

The most interesting feature of the hospital, of course, is the survival complex which is being constructed as a shelter against fallout radiation according to the specifications of the Office of Civil Defense Mobilization.

The vital services are being housed in two floors underground. These include X-ray, laboratories, central service, surgical operating room, recovery room, kitchen and dining room, stores, emergency service, and tremendous areas of storage space equipped with oxygen and suction outlets for use in a disaster.

The survival complex is designed to enable hospital personnel and patients plus a limited number of outsiders to maintain themselves for 14 days in complete safety even though the entire outside area be destroyed or completely saturated with lethal radiation.

The problems of ventilating and cooling this area are similar to those confronting the designers of a submarine. An enormous amount of standby electric generator equipment will be included in the complex and the hospital will have special wells drilled into the survival complex so as to give an adequate supply of water for drinking, washing, cooling, and decontamination in the event of the destruction of the city water mains. The hospital is located on high ground so that sewage and decontamination water can be disposed of rapidly by gravity.

The intensive care unit will feature remote control instrumentation and telemetering devices which, up to now, have been used only in research institutions. Surgical operating rooms will be conventional as will be laboratories and central service even though the very latest design in equipment will be incorporated in these departments.

The X-ray department, however, will feature remote control fluoroscopy which will enable the radiologist to conduct examinations in a lighted room without fatigue and to provide better radiography by using motion pictures instead of still films taken at random. It will have a capacity of about five times the output of the conventional fluoroscopic installation.*

The hospital will, of course, have a heliport and may even maintain its own helicopter ambulances if public services fail to provide these.

What would happen to this survival complex in the event of atomic attack is anybody's guess. Although it is planned only as a 14-day shelter, the

*Letourneau, C. U.: Motion pictures and television improve X-ray techniques. Hospital Management 86:51 (October) 1958.

designers have planned it so that it could be used to handle disaster casualties. The position of the decontamination unit is such that, in the event of attack, it would not be manned by hospital personnel but by specially trained civil defense experts in decontamination and radiation safety.

The emergency area is entered via the upper level of the survival complex. In the event of atomic attack, leaded radiation-proof doors will slide into position sealing off the survival complex completely. They will be opened to admit patients only upon the instructions of the officer in charge of civil defense protection.

Construction is expected to be completed within 2 years and, at the end of this time, research tests will be conducted to determine how efficiently the survival complex functions. Since it is the first such installation, it is inevitable that some unforseen situations will be revealed after the building is constructed. Some mistakes will undoubtedly be made because the possibilities of resisting atomic attack are still largely in the realm of conjecture. The mistakes discovered in this survival complex will be corrected in the construction of the next. Each succeeding one will be an improvement over the last until we can finally obtain some reasonable assurance that we have developed a fairly good defense against nuclear attack.

NEW HOSPITAL DIGS IN FOR FALLOUT SAFETY

By locating the hospital on a hillside, the planners utilized excavation and backfill to provide protection to the shelter area

A. Chester Conrow and Jack A. White

When the new Saint Barnabas Medical Center, now under construction in Livingston, N.J., is completed in 1963 it will incorporate, among many unusual construction features, two floors designed to provide protection from radioactive fallout.

On these first two floors of the six-story building are located all of the basic services and professional facilities plus 75 patient beds. Each floor covers approximately 2½ acres, and the entire shelter area can accommodate an estimated 1,100 persons for a minimum of 14 days.

Location of the building on a hillside made it possible to take advantage of both excavation and backfill to provide protection for the ground floor, 95 percent of which is actually underground.

Situated on this floor are: A 500-seat auditorium, telephone communication and radio center, formula room, library, medical records department, medical staff lounge, five classrooms, research laboratories, physical therapy department, central supply, morgue and autopsy room, general stores, maintenance shops, incinerator, dietary service, housekeeping, laundry and locker rooms, and the boiler house.

The first floor is above ground and contains the professional services, the surgical concentrated care unit (52 beds), the admission and diagnostic unit (23 beds), administrative offices, outpatient department, and rehabilitation center.

Because it is above grade, the first floor presented problems of adequate shielding. Thickness of the exterior was increased from the normal 4-inch face brick and 6-inch concrete block backup to a solid 12-inch brick wall.

Mr. Conrow is administrator of Saint Barnabas Medical Center, Newark, N.J. Mr. White is assistant administrator. Plans for the fallout-proof hospital were developed with the assistance of State and National civil defense officials in cooperation with the hospital architects, Ferrenz & Taylor, New York City. The medical center was begun under the administration of the late Dr. George C. Schicks.

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The fan rooms could be a prime source of contamination of the shelter area, so they were also enclosed with 12-inch masonry walls. To prevent excessive amounts of radioactive dust from entering through the air intake of the fan rooms, a special baffle, or housing, was used to deflect or permit the particles to settle before they could be sucked into the filters of the ventilation system. Carefully designed baffle walls were used also to protect primary exits and entrances to the shelter area so it can function as a hospital during normal operation.

Service and ambulance entrances required special treatment since they must be completely operable during a fallout period.

Trucks and ambulances can be driven in under cover and will be decontaminated before they are unloaded. Supplies will be received on the ground floor. The deck of the ambulance court forms a roof over the receiving area and the court itself is completely roofed over with a concrete slab. Six ambulances can be accommodated in the court, under cover, at one time.

Housing 1,100 persons for a minimum of 14 days creates special problems of ventilation, light, water, and waste disposal.

The air-conditioning system was increased in capacity by approximately 70 tons and many areas that normally would have only exhaust ventilation have additional supply ducts. Thus, the shelter will have available at least 750 tons of air-conditioning. All air intake units here are equipped with a combination of continuous mat filters and electrostatic filters to remove radioactive particles from the air. To make the entire hospital safe from any type of gas warfare, the ventilation and circulation ductwork is designed to accept special filters and additional booster pumps.

To insure a continuous and uncontaminated source of water, an 800-foot well was driven and is producing in excess of the 200 gallons per minute required to operate the shelter area. The well and pump are located in the boiler house.

General sewerage is provided for with a generous distribution of toilet facilities on the first two floors, an independent water supply, and a gravity-flow sewer system. Wet and dry rubbish will be destroyed in an 800-pound-per-hour incinerator located within the shelter area.

A considerable area has been allocated to primary and secondary storage of supplies of all types: Food, linens, drugs, medicines, and surgical instruments. The central supply room is even equipped to produce parenteral solutions in an emergency.

It is estimated by the hospital architects, Ferrenz & Taylor, that the cost of incorporating the shelter in the hospital will be more than $500,000. Approximately $400,000 of this will be met by the Office of Civil and Defense Mobilization.

THE MODERN HOSPITAL OF THE MONTH

Disaster planning preceded the blueprints

for all-new Forsyth Memorial Hospital

Modernization is fine but totally new construction is better, taxpayers in Winston-Salem, N.C., can testify as they compare their 540-bed Forsyth Memorial Hospital with the old structure that for 50 years was known as City Hospital.

And though nurses from the old 245-bed hospital haven't yet become entirely accustomed to their new and oversize 60-bed nursing units, they and all others are uniformly delighted with the $15 million, nine-story hospital and nursing school opened a year ago. Built with nearly $5.5 million in Hill-Burton funds, contributions, and county tax money, the replacement hospital has such features as:

- Piped oxygen and vacuum in not only patient areas but also in lobbies and other available areas to allow accommodation of as many as 1,000 patients in a disaster.
- Extensive fire safety provisions based upon lessons learned from the Hartford Hospital fire.
- Also for disaster needs, multiple electric power sources, emergency electric power generators, dual-fuel boilers, and dual sources of water supply all were provided as precautions against interruption of mechanical services.
- Extensive electronic data processing of business paperwork.
- New patient services unavailable in the old hospital, such as intensive care (12 beds), a recovery room (17 beds), and a psychiatric unit (26 beds).
- Three closed-circuit television systems, one to allow child visitors to "visit" with sick parents, one to monitor the emergency entranceway, and the third to allow pediatrics nurses to observe their patients.

Administrator for Forsyth Memorial Hospital is T. R. Matherlee. Architects are Lashmit, Brown & Pollock of Winston-Salem; Milton Glaser Associates of Richmond, Va., coordinated interior decoration, and Richard Iuen was food services consultant. Hospital consultant for the project is Dr. Herman Smith, Chicago.

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- A large outpatient department that includes the former dental clinic for indigent and handicapped run by the city-county health department.
- A completely modernized radiology department with cobalt therapy, image intensifiers, and all-new diagnostic machines.

That public officials could build so generously is something of a tribute to the leadership of the voluntary board (appointed by county commissioners) and hospital personnel, many of whom contributed long hours after their regular workdays at City Hospital.

But, ambitious as the project was, it is only a beginning: Contracts were recently let for a $1 million, 64-bed convalescent wing, and the county is committed to the eventual erection of another 540-bed hospital adjoining the present facility.

Indicative of public support is the $10 million bond issue approved by voters to help finance the hospital. As it turned out, however, some $2 million was raised in gifts and $2.5 million was funded from tax receipts, leaving only $5 million in bonds to be sold.

Evidence that a twin structure is not an entirely fanciful notion was the 90 percent occupancy reached in medical-surgical units of the present facility this year.

As a public hospital a number of economies were achieved that presumably reassured local taxpayers. The laundry, for example, is run on contract with the State prison system (at a saving of some $90,000 a year). A local industry made its purchasing department available for more than a year and through it all group II and group III equipment was purchased.

The school of nursing building, where all corridors are carpeted, received all its groups II and III equipment as gifts. The hospital saved thousands of dollars also when a local freight line donated its services to move equipment to the hospital.

"Solid and Practical Design"

Judges on the Modern Hospital panel of consultants recommended Forsyth Memorial Hospital for recognition, calling it "a solid and practical design."

"The hospital is very well planned and equipped for a complete range of diagnostic and treatment services for both inpatients and, in a large facility, outpatients," the judges commented.

The hospital rises nine floors above a full basement and has a 10th level penthouse for air-handling equipment and the pneumatic tube centers. The basement and first floor are large rectangular blocks with an L-shaped wing on the west for laundry, morgue, boiler room, and shops.

On the main floor is the administrative department, a handsome lobby, an adjoining chapel with a full chancel wall of modern stained glass, outpatient and emergency departments, and a large surgical suite of 11 operating rooms.

The architectural judges questioned the 17-bed capacity of the single recovery room, but otherwise had only praise for the planning, particularly for the "good supporting areas and equipment" of the surgical area.

Spacious kitchens are located in the basement and food is delivered in unheated carts with hot pellets maintaining food temperature. The service is managed by a food contractor and present costs per meal are running 77 cents, Administrator T. R. Matherlee reported recently.

Nursing floors from the second through the fourth floors are cruciform in plan (the pattern of upper floors) with an additional leg to the left arm of the cross, forming a double-T pattern. This leg provides the obstetrical suite (four delivery rooms, eight labor beds, and four recovery beds) at one end of the second floor and a nursery unit of six rooms at the other end.

On the third floor, this leg provides a 30-bed pediatric unit, and on the fourth floor the extension provides the special unit for psychiatric patients.

However, the basic nursing units on these floors are, as previously noted, 60 beds served from a nursing and service unit at the intersection.

"Our only big problem since moving into our new hospital," Mr. Matherlee told the Modern Hospital, "has been getting our nurses to function effectively in these large units." In old City Hospital, most units had from 25 to 35 beds.

An extensive inservice orientation and training program is underway, financed in part by a Federal grant, to develop appropriate staffing patterns for these nursing floors. In this and other training, Mr. Matherlee expects to provide training for some 400 personnel in 10 job classifications by the end of the year.

OUTLINE OF CONSTRUCTION COSTS
Forsyth Memorial Hospital, Winston-Salem, N.C.

Total project cost		$13,219,421.53
Number of beds	542	
Bassinets	59	
Medical-surgical	500	
Obstetrical	42	
(Planned for 540 additional beds)		
Cost per bed		24,390.08
Total square feet	338,068	
Square feet per bed	626	
Cost of group I equipment		*59,761.40
Cost of group II equipment		1,834,909.63
Cost of group III equipment		104,232.41

*Includes nurses' residence and school of nursing. Remaining cost for nurses' residence: $1,393,692.08.

This hospital has been selected as the hospital of the month by a panel of consultants. Award certificates are being presented to the hospital, the architects, the hospital consultant, and the State Hill-Burton agency.

Maximum travel from nursing station to corridor ends is 100 feet. Most rooms are two-bedded, but each floor includes four units of four beds each and there are a total of 170 oversized private rooms. These are large enough to allow a second bed as expansion becomes necessary.

In anticipation of the eventual twin unit, space that will be needed for connecting corridors has been designed as storage or as easily moved departments. Mr. Matherlee expects to move the outpatient department when the second building is built, using that space for expansion of laboratory and X-ray facilities.

Critically important in so predominantly vertical a design, mechanical transportation at the hospital was generously provided. A bank of two 500-f.p.m. elevators with duplex collective control serves the food service, supply services, and housekeeping. Another bank of four elevators in the central tower is designed with automatic dispatching and selective positioning to handle peak visitor loads. One or two cars may be placed on separate control through a cutout feature to allow movement of patients to surgery, X-ray, and other departments.

Commented the architects, "The building functions efficiently. The atmosphere is pleasant. Its satisfaction in use stems not only from the participation of all the consultants, but also from the analysis and consideration given to the suggestions of the several official and unofficial groups and individuals during the design process."

COMMUNICATIONS

WALKIE-TALKIES IN THE DISASTER KIT

Communication problems, which exist in any hospital, are multiplied in times of external disaster

Gerald R. Glaub

Ever since the first conscientious hospital started preparations for handling an external disaster, communication breakdown has been a problem. A train wreck, a tornado, or any other catastrophe involving a large number of casualties can flood a hospital emergency department swiftly and unexpectedly with individuals needing immediate medical attention. For this, to some extent at least, a hospital can prepare.

However, no amount of careful planning can avert the multitude of telephone calls that are certain to tie up the switchboard. Even in a disaster drill, where there are no hysterical phone calls, internal communication can present a problem.

The importance of this problem was demonstrated in two such drills at the University of Illinois Hospitals in Chicago. The experience during the first drill with busy interoffice telephones and an inadequate student messenger system pointed out the full effects of the communication problem and prompted the hospital administration to search for a solution.

Use of Walkie-Talkies

It was at this point that the use of walkie-talkies—portable two-way radiotelephones—for internal communication was suggested. A second disaster drill proved the portable phones successful in maintaining a constant line of communication between the hospital control center and the key areas—casualty sorting, operating rooms, and personnel and equipment pools.

The control center must know at all times was is taking place at key spots throughout the hospital. It is this nerve center which keeps the disaster teams functioning smoothly and effectively. But without constant communication with these areas, the medical director, who acts as disaster control

Gerald R. Glaub is assistant manager, Office of Public Information, University of Illinois Chicago Professional Colleges, Chicago.

The author wishes to acknowledge the help of Dr. Donald J. Caseley, medical director of University of Illinois Hospitals.

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officer, can only sit and wonder and piece together the fragments of information he receives from excited messengers.

During the first drill, the disaster control officer found himself relying on telephones that were usually busy and on messengers who could not be expected to know all the geography of the four buildings comprising the hospitals, or to recognize all faces and answer all questions. By using walkie-talkies, during the second drill, the control officer found himself in a different situation. He was always in contact with someone who could answer his questions, and the heads of key areas could always turn to him for answers to their own questions.

For example, the control officer was immediately aware of a large number of orthopedic casualties arriving in the triage area, and he was able to inform the equipment pool what equipment was needed on the orthopedic ward. In this case, however, there was no walkie-talkie on that particular ward, so he used a messenger.

Also, during the first drill, the control officer had to rely on written reports by clerical assistants in the triage area. This procedure caused a delay, which increased with each step in the disaster chain, because there could be no preparations by the ward areas in advance of the arrival of the patients.

Direct communication using the walkie-talkies brought more accurate information compared with the "second-hand" relays of the messengers.

Effective Communication

Part of the University of Illinois Hospitals' disaster plan included sending out a "roving expediter" who had a good working knowledge of the overall plan. For him, the walkie-talkie not only cut down the amount of walking involved, but also increased the speed with which the control center could adjust operations to a turn of events anywhere in the hospitals. For example, knowing that a certain quantity of blood sent to the postoperative area was insufficient because the area was suddenly thronged with casualties, the expediter was able to radio the control center immediately.

Operations which were hampered by an equipment or personnel shortage were reported to the appropriate areas via the control center. When a high percentage of casualties in the triage area were of a certain classification, personnel and equipment were transferred from an area handling fewer casualties to the ward with the greater load. (But only the control center can order drastic changes in the disaster plan if any semblance of order is to be maintained.) With a premium on time, therefore, the expediter with a walkie-talkie was of incalculable value.

Walkie-talkies also help solve a frustrating problem in the operating rooms. Although not knowing what types of casualties are coming from the triage

area, the surgical control officer must be able to gage the priority of operative cases. His chief consideration is that there may be some patients in the sorting area who need surgery more urgently than those patients already in the waiting rooms.

Walkie-talkies enable the surgical staff to choose high priority casualties first. In other words, good communication permits the scrapping of the injudicious "first come, first served" procedure.

Limitations of Walkie-Talkies

While the use of walkie-talkies solved most of the major communication problems involved in the second mock disaster, it was not an overall solution. Walkie-talkies even presented a few minor defects of their own.

Among the unsolved problems were:

1. Some types of information should be in writing. These include orders for drugs, particular blood types and special equipment of a precise size or kind.
2. Only a few people can have access to the walkie-talkies, while others must rely on messengers.
3. Noise interferes with hearing the walkie-talkies.
4. Trained personnel are needed to handle the walkie-talkies.

Since the walkie-talkie are mechanical, they are not failure-free. Periodical checks and care to maintain the batteries make the walkie-talkies reliable to the extent that they facilitate coordination of the disaster plan by improving communication. However, total collapse of communication may result if a battery goes dead, a phone is dropped and damaged, or a mechanical part fails to function.

Three of the portable phones were employed during the second drill. They were all tuned to the same frequency so that the two located in key areas could communicate with the one in the control center. Four or possibly five walkie-talkies can be used effectively on the same frequency. More than that, however, will result in typical "party line" confusion. During the drill it was found that there was no interference with the three phones, and that they were effective as far away as two blocks. The only time the phones were difficult to use was when one of them was in a deep basement area.

Walkie-talkies might also be useful in the receiving lobby for relatives of casualties, in assisting with traffic control at the emergency entrance, and in maintaining liaison with public information officers.

The University of Illinois Hospitals plan to keep relatives away from the physical facilities of the hospitals by receiving them in a building across the street. Messengers will be used to convey casualty lists to this information

center. The hospitals also intend to explore the possibility of using a walkie-talkie to keep in contact with this center.

Solving the communication problem will not solve the problems of traffic control and handling of relatives and friends. But the relationship between communication and these problems is a direct one. As the control center's contact with the key areas falters (resulting in loss of control over the disaster situation), the other problems mount in number and intensity. Poor communication can result in clogging of the emergency entrance and sorting areas. Also, hysteria in the information center is another potential problem which can be stopped by effective communication.

Thus, walkie-talkies, while solving one of the greatest problems involved in handling an external disaster, also lend themselves to combatting other obstacles.

IS SHORT-WAVE RADIO IN YOUR DISASTER PLAN?

Everything's up to date in Kansas City—including short-wave, two-way radio communication in hospitals for disaster service, ordinary emergencies, and just routine business

Susan S. Jenkins

Short-wave radio installations now link most Kansas City hospitals into a communications network set up by the Kansas City Area Hospital Association just a year ago. The system has a dual function—to maintain communications in a disaster and to serve day-to-day needs of hospitals through base to mobile and portable units.

Four years ago a tornado ripped through a Kansas City suburb, sending more than 300 patients to hospitals. Worst problem was a breakdown in telephone service, not from storm damage but through overload on exchanges by a frantically calling public. With communications out, casualty loads piled up at a few hospitals while others were bypassed. Out of this experience have come the short-wave radio system and a centralized disaster operations service. Both of these systems are proving their worth.

Recently the PBX operator at the North Kansas City Memorial Hospital looked anxiously at the flickering green lights on her switchboard. First one trunk line out, then another, and another. Even as she watched, the last of the trunks went dead and the hospital was out of communication with the outside world. Then even inside stations ceased working and telephones were totally silent.

Some 2 miles away a bolt of lightning from a small thunderstorm had blown open a lead-shielded cable carrying all of the hospital's telephone lines—even the pay station phones which did not come through the switchboard. As water soaked into the ripped cable, the wires went dead, one after another.

Miss Jenkins is executive director, Kansas City Area Hospital Council, Kansas City, Mo.

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The telephone blackout lasted more than 6 hours, but communications were maintained and emergencies handled through the hospital's radio installation. Here's how it worked.

James R. Rich, administrator, rushed the hospital's two mobile units and a portable unit to his home. Calling the telephone company, he arranged rounting of all incoming calls through the intercepting operator for screening. People who were just making casual inquiries as to patients' conditions were told to call later, but necessary and urgent calls were routed to the administrator's home number. Messages were then relayed to the hospital's base station by radio.

At the hospital, outgoing calls were handled over the same route by the operator with a microphone at the switchboard. "Walkie-talkie" units within the hospital extended communications to departments.

Many doctors' orders, some urgent family messages, blood bank requests, two deliveries, an automobile accident, and several lesser emergencies were handled smoothly. But it takes little imagination to envision a busy hospital with no outside communications at all for 6 hours.

Two months before the North Kansas City incident, tornado warnings had been issued by the weather bureau and relayed directly to the control station on the hospital radio network. A group call immediately alerted all hospitals on the system. However, three hospitals in the Kansas City metropolitan area were not yet on the network. All are on the same telephone exchange. When the disaster operations staff tried to alert these three by telephone the exchange was overloaded by an anxious public calling family and friends about the sighting of funnel clouds. There was the usual dial tone on the line but no ring. The hospitals could not be reached for the alert.

While Disaster Director Dr. Grosvenor Roberts debated dispatching mobile radio units to the three hospitals, the funnels raised and passed harmlessly away from the city. They might not have.

The disaster operations service of the Kansas City Area Hospital Association is a new approach to an old and knotty problem—how to coordinate hospital operations in a community with several hospitals when an emergency or disaster hits. Lifeline of the service is the radio communications network.

A disaster operations staff, functioning much like a volunteer fire department, stands ready to report, day or night, to the primary control station at the University of Kansas Medical Center. Here is radio equipment to reach not only all hospitals on the system but also the American Red Cross and its mobile transmitter at the disaster field, the police department, and the fire department.

Civil defense in Kansas City, Mo., works through the fire department. Other CD agencies may tie in through cross receivers to achieve two-way communications with the hospital network.

Backing up the primary station is a secondary control center at the Kansas City General Hospital, with most equipment duplicated in case primary control is made inoperable by a disaster. Taller antenna structures at both control points give these stations a farther reach.

At the control center are the disaster plans of all hospitals in the area, a large wall map of the urban region with traffic arteries and travel time zones, and access layouts of hospitals showing location of ambulance entrances, emergency rooms, and street approaches. There is a list of vendors of hospital and pharmaceutical supplies, with business and home addresses and telephone numbers for round-the-clock service. In a disaster, hospitals' orders would be consolidated over the radio network. Deliveries would be made direct to each hospital, either by the supplier or by the staff messenger service.

Location of Supplies Listed

A card inventory of special items of equipment and supplies shows the hospitals where these are located and the quantity available. This file has been duplicated for use by the individual hospitals where speedy sharing of certain pieces of equipment can mean substantial savings to the community.

Other equipment at the control center includes Conelrad monitor for national emergency alerts; AM radio to monitor news reports to the public, telephones and tape recorders for keeping a record of all operations.

Through the radio network, casualty lists can be compiled from all hospitals and released at frequent intervals to the press. Adjacent to the control station is a central pressroom equipped with typewriters and telephones. The release of information about casualties through a central source speeds up the process and relieves hospitals of serious pressures.

A year's exploratory work preceded the final selection of radio equipment by a special committee of the Kansas City Area Hospital Association. Final decision was also influenced by a study and report of a firm of consulting engineers.

First thought was that the amateur radio operators' organization, the "hams," could handle the communications job. The "hams" themselves decided against attempting it, but they do offer a valuable supplementary service.

Then a few hospitals offered suggestions for getting Government surplus equipment, or inexpensive but little known commercial equipment. The consulting engineers pointed out that to function as a system or network, the equipment should be the same for all hospitals. This would enable group calls to be made by any base station or control center—for only two or three hospitals or to all simultaneously. It was also pointed out that the equipment must be durable enough to stand up under long hours of continuous use during a disaster.

Service contracts were recommended by the consultants, since radio equipment is worthless unless it is in perfect working order. Experience has proved the value of these contracts.

The initial cost for most hospital base stations was a little under $2,000. This varied some, depending on the number of monitors, call consoles, and microphones that were desired by the hospital.

For continuous coverage, hospitals have monitor receivers at their switchboards. Some have call consoles and microphones also at the board so the PBX operator can carry on conversations if necessary. Otherwise when a message comes in, the operator calls a designated person in the administrative staff to receive the message. The monitor receiver is silent until the hospital is called, then a tone signal automatically opens the unit.

Most administrators have call consoles and microphones in their offices, some in other locations such as the emergency room. The equipment takes up about as much space as a typewriter.

Transmission is just about as simple as a telephone. No technical training is required and no special proficiency is needed for a license. However, the Federal Communications Commission has regulations for operation which must be followed explicitly. These include the keeping of a log of transmissions.

Group test calls on the radio network are made at frequent intervals by the disaster operations staff, to assure familiarity with the equipment and to see that it is working properly at all times.

Although the system is set up and geared for disaster, Kansas City's hospitals are finding increasing uses for their radio installations in day-to-day operations.

Administrators with mobile units in their cars can keep in constant touch with their hospitals. Units in service cars mean savings in time and gas as employes can be directed to make additional stops while out on errands. Transistorized pocket units or portable "walkie-talkies" are proving valuable for construction projects, maintenance staff, guards at parking lots, roving administrative staff, and various key personnel. More of these units are being added all the time.

Kansas City hospitals, with the exception of the municipal general hospital, do not operate ambulance services. For hospitals which do operate ambulances, however, two-way radio offers great advantages.

Some early apprehensions that the airways would become cluttered with too much transmission have failed to materialize. Sometimes the channel is busy, but messages are kept brief and to the point. Portable units used within the hospital are low powered and do not transmit beyond the hospital's base station.

All of the radio equipment can operate on auxiliary power or even storage battery. The base station transmitter uses about as much electricity as an ordinary light bulb. The radio network at present spans approximately 25 miles across the Kansas City metropolitan area, but could probably reach 40 miles.

HOW TO MAKE TELEPHONE DISASTER-PROOF

Hospital telephone communications problems that occur with major emergencies are preventable by using special keys, restricted and unrestricted phones

David V. Shaw

"Telephone lines soon became so clogged with calls for information that they were useless for communications between hospitals and disaster agencies."—October 31, 1963, explosion at the Indianapolis Coliseum. "Hospitals Find Lack of Communications a Problem During Jacksonville Hotel Fire."—December 29, 1963. But such problems need not happen. Here is how some hospitals have avoided them.

A "break central office trunk hunt key" is installed at the switchboard of a 1,000-bed hospital. According to the hospital's disaster plan, when authorized by administration, the chief operator throws the special key.

Assume the hospital's telephone number to be 555–2000 (area code 311) and that it has 50 trunks, numbered from 2,000 through 2,049. Normally, all incoming calls will hunt the next idle trunk and no caller will ever get a busy signal, except in the rare eventuality that all 50 trunks are busy.

When the break central office trunk hunt key is thrown, however, this breaks the search after the first 20 trunks. Then all incoming calls will hunt the next idle trunk from 2,000 through 2019 only.

Whenever the first group of 20 trunks are all busy, incoming callers who have dialed 555–2000 will get a busy signal. This leaves a second group of 30 trunks available for incoming calls from disaster agencies. All that is then necessary is to inform other hospitals, hospital associations, hospital councils, and disaster agencies of the hospital's second unlisted telephone number, 555–2020.

One important point: Since the second group of 30 trunks need not necessarily hunt within themselves after the key is thrown, it is vital to specify this when ordering the break central office trunk hunt key.

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A second approach offers day-to-day usefulness as well so a hospital need not pay every month for equipment that is used rarely or not at all.

For example, a 400-bed hospital has a switchboard with 10 trunks that hunt with an unlisted number unrelated to its listed number—even to the extent of operating out of a different central office.

This unlisted number is given out only to administration and members of the medical staff.

Like most hospitals, all incoming callers on the listed number asking to be connected with any nursing station, the operating room, the delivery room, or any other department, are requested to identify themselves. This takes operator time.

All incoming callers on the unlisted number desiring connections with these areas are, however, instantly made without question on the presumption they are authorized. This saves operator time.

An option is that the unlisted number need not be answered with the hospital's name, but can be answered only with some nonidentifying phrase.

Less Expensive Alternative

There is a third approach that is less costly than the two discussed in the foregoing.

Often outgoing calls are automatically routed over different trunks than those used for incoming calls. Ninth level trunks are commonly one-way only, being intentionally so wired that it is impossible to receive an incoming call over them at any time. Changing all of these, usually at no increased charge, to "two-way combination trunks" and giving them an unlisted number that hunts can accomplish the same purpose as the second approach.

A corollary of this may be less apparent but can be just as real and equally serious. A hospital's outgoing trunks can be so jammed up with outgoing calls that administration may be completely unable to make any calls to other hospitals.

Hospital employes not yet involved in the disaster may be making calls and jamming the outgoing trunks. This also need not happen.

Most hospitals have telephones that are unrestricted, from which anyone may dial 9, for an outside dial tone. Such hospitals also have telephones that are restricted, from which, were anyone to dial 9, they would hear only what sounds like, but is technically different from, a busy signal.

The Restrict-at-Will Key

A "restrict-at-will key" will change one or a group of unrestricted telephones to restricted, back and forth, ad libitum.

The opposite of this situation may likewise occur. Certain disasters, requiring the making of many outgoing calls, may be programed for areas where normally no outgoing calls are originated.

In virtually every hospital, outgoing calls can be made from restricted telephones by dialing O for the hospital operator, and having her either connect the caller with a trunk or dial an outside number.

Whenever a hospital activates its disaster plan, however, it is important that outside calls continue to bypass the switchboard. At such a time it is essential to route fewer—not more—outside calls through the switchboard.

Even with a break central office trunk key, the traffic volume will be too heavy for switchboard operators to handle the additional load of outgoing calls.

No hospital can justify the expense of extra switchboard positions, never used except during a disaster, even if they could be staffed. A restrict-at-will key can normally be kept in the restricted position and can be changed to the unrestricted position.

Restrict-at-will keys, which also have day-to-day applications, can be wired in three different ways.

One can be wired to a single telephone or to a small group of telephones; one can be wired to the equipment that controls a large group of telephones, usually 200; or, one can be wired to the equipment that controls all telephones. Theoretically, every telephone can have its own individual restrict-at-will key, all in one central location.

Hospitals have therefore, several choices available.

Several restrict-at-will keys to control individual or a few telephones each are appropriate for medium-sized hospitals.

Effective for very large hospitals is to permanently assign all extension numbers in three groups, each of 200 telephones or larger multiples thereof.

The first group would be those telephones that are normally unrestricted, but that should be restricted in time of disaster. The second group would be those telephones that are normally restricted, but that should be unrestricted in time of disaster. These two groups would each have one restrict-at-will key. The third and largest group, which would need no restrict-at-will key, would be a random mixture of both unrestricted and restricted telephones to remain unchanged in time of disaster.

A choice appropriate to large and small hospitals alike is to "double-wire" all outgoing trunks, not only to the ninth level, but also to another level—assume the seventh level.

The Meaning of "Level"

(Every dial system actually has 10 levels, numbered 1 to 0, but only the 9th is commonly called a level. The uses of the various levels break down this way: the zero level, always for trunks to the hospital's or company's own switchboard operator; the second through fifth [sometimes sixth] levels, extensions at the rate of 100 for each level; the seventh level [sometimes the sixth level], foreign exchange trunks if there are tielines; the eighth level, domestic tielines; and the ninth level, local trunks.)

With the double-wire system, each telephone would be made unrestricted or restricted in the ninth level for normal conditions. Independently, each telephone also would be made unrestricted or restricted in the seventh level for disaster conditions.

There would be two restrict-at-will keys: one each on the seventh and the ninth level. When these two keys are thrown, all telephones would be restricted in the ninth level, but two different, overlapping groups of telephones would become restricted and unrestricted in the seventh level.

All the hospital's administration need do is incorporate in the disaster plan instructions that whenever it is activated outgoing calls cannot be made by dialing "9," but only by dialing "7."

One other condition conceivably could be experienced by hospitals, albeit only during a disater of truly catastrophic proportions. For it, too, there is a solution, but it is a drastic one.

Hospital dial systems, like those in cities and towns, all have capacities in terms of maximum simultaneous conversations. Hospitals, like telephone companies, cannot hope to have enough equipment to cover extreme eventualities. It is possible so many telephones may be in use for inside calls that administration may pick up a telephone for an emergency call, inside or outside, only to find an all-circuits-busy condition, evidenced by no dial tone.

Most telephone company central offices have a key that they treat with as much respect as the Government would treat any key that might exist to start a thermonuclear war.

Every telephone in a city or town has been classified as to necessity or nonnecessity. For example, the home telephone of every hospital administrator is classified as essential. When that key is thrown, every nonessential telephone will immediately go dead. A hospital may similarly classify its own telephones and have its own key.

Other hospitals developed still different solutions to communication problems, both to and from disaster agencies.

A 300-bed institution has a tieline between the hospital switchboard and the police headquarters switchboard—as distinguished from the separate police emergency switchboard in many cities. This has so many day-to-day uses that every hospital, from the largest to the smallest, should have one. Sometimes the police department may pay half the cost.

If a hospital without ambulance service could connect the occasional caller requesting an emergency vehicle directly with the police, it would be a good public relations gesture.

An alert operator can, without the knowledge of an outside caller, set up a three-way connection with the police for the occasional threatening, obscene, or bomb hoax calls to which hospitals are prey.

A 1,300-bed hospital has four different direct lines to the police. In addition to the foregoing, it has two automatic ringing private lines to individual police stations.

These private lines are often called hot lines, a term that means different things to different people.

In the hospital's emergency room are two direct extensions of the police headquarters switchboard. Primarily for police officers to report in after bringing in accident patients and for dispatching, the extensions also are used by hospital personnel to dial directly to any city police station, headquarters telephone, or police emergency switchboard.

An option is to replace all four lines with one or two dial-repeating tielines so any hospital telephone user can dial directly to any city police telephone and vice versa, without involving an outside call, merely by dialing one extra digit.

The Red Light System

A 700-bed hospital terminated its lowest extension number, not in a telephone instrument as is normal, but in a trunk jack on the switchboard. The hospital's fire instructions say to pick up any telephone and dial 2100. This lights a red lamp cap at the switchboard, which takes priority over all other traffic. An option is multiple terminations, so that every operator on the switchboard can plug in simultaneously. All will thus hear the message to eliminate any misunderstanding and each can then notify a different person, to disseminate the word more rapidly.

A 200-bed hospital changed its most easily remembered number (222) into what may be termed a three-legged tieline. Whenever 222 is dialed from any telephone in the hospital, it rings simultaneously in three places, at the switchboard and fire and police headquarters. Both know without being told that the hospital is calling.

And if the hospital, police, and fire officials desire, the message may be automatically tape-recorded so it can be played back in case of misunderstanding. The switchboard verifies that the message was received by both without delay for a second and third call.

For any hospital, it is better to call the fire department unnecessarily than too late. In addition, to handle the inevitable traffic jam, the police department wants to know of any hospital fire almost as soon as the fire department.

APPENDIX

Publications

The Division of Health Mobilization has prepared a number of publications for the guidance of those responsible for, or directly interested in, assuring the adequacy and preparedness of health facilities in a disaster. Publications in the Health Mobilization Series are divided into ten subject categories, which are listed on the inside back cover of this book. The publications listed below are available, upon request, from your State Health Department, Civil Defense office, or the Division of Health Mobilization, Public Health Service, Washington, D.C. 20201.

Emergency Health Preparedness Publications Catalog (1966) PHSP No. 1071–A–1.

Community Emergency Health Preparedness (1964) PHSP No. 1071–A–2.

Health Materiel and Facilities Planning Guide for Emergency Management (1965) PHSP No. 1071–A–4.

Therapeutic Guide for Pharmaceuticals in the Packaged Disaster Hospital (1965) PHSP No. 1071–C–1.

Establishing the Packaged Disaster Hospital (Revised 1966) PHSP No. 1071–F–1.

X-ray Section of the Packaged Disaster Hospital (1966) PHSP No. 1071–F–2.

Central Sterile Supply Section of the Packaged Disaster Hospital (1966) PHSP No. 1071–F–3.

Laboratory Section of the Packaged Disaster Hospital (1966) PHSP No. 1071–F–4.

Operation of Generators in the Packaged Disaster Hospital (Revised 1968) PHSP No. 1071–F–5.

Water Supply Management in the Packaged Disaster Hospital (1965) PHSP No. 1071–F–6.

Nurses' Ward Management Guide for the Packaged Disaster Hospital (1965) PHSP No. 1071–F–12.

Pharmacy Section of the Packaged Disaster Hospital (1966) PHSP No. 1071–F–13.

Assembling Equipment in the Packaged Disaster Hospital (1966) PHSP No. 1071–F–14.

Illustrated Catalog and Guide for Distribution of Packaged Disaster Hospital Materials (1965) PHSP No. 1071–F–15.

Check List for Developing a Packaged Disaster Hospital Utilization Plan (1966) PHSP No. 1071–F–16.

General Stores Section of the Packaged Disaster Hospital (1966) PHSP No. 1071–F–17.

Hospital Planning for Nuclear Disaster (1965) PHSP No. 1071–G–1.

Community Emergency Health Manpower Planning (1964) PHSP No. 1071–I–1.

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Publications in the Health Mobilization Series are keyed by the following subject categories:

A—Emergency Health Service Planning

B—Environmental Health

C—Medical Care and Treatment

D—Training

E—Health Resources Evaluation

F—Packaged Disaster Hospitals

G—Health Facilities

H—Supplies and Equipment

I—Health Manpower

J—Public Water Supply

Public Health Service Publication No.1071-G-2
Revised 1968